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THE LIMITS SET TO EDUCATIONAL ACHIEVEMENT BY LIMITED INTELLIGENCE[1]

MARGARET V. COBB

Institute of Educational Research

Teachers College, Columbia University

I. Previous Estimates of the Limits of School Progress

Very few figures are available which show definitely the maximum school progress that is possible for children of any given level of intelligence, either in terms of rate of learning, or in terms of the upper academic limit of their achievement. Dr. Terman (1), in connection with the description of the Stanford-Binet Scale, gives general statements the substance of which is that children below 75 IQ should be kept out of regular classes, and will rarely be equal to the work of the fifth grade, however long they attend school; that for children below 80 IQ, special classes are advisable and work should be concrete; that children 80 to 89 IQ will usually be able to reach Grade VIII after from one to four failures; that those from 90 to 109 may enter high school, but marks will be below average there and excessively poor in college; that those from 110 to 119 should complete eight grades in 7 years and are "good" scholars in the grades, average in high school. Children who stand better than 120 IQ, he says, are so intelligent as to be seriously hampered in an ordinary classroom. Later, in "The Intelligence of School Children," (2) he says, "Throughout Proctor's study it appears that the standards of work which are maintained in the first year of average California high schools can not be satisfactorily met by pupils with a Stanford-Binet mental age below 13 years, and that below the mental age of 14 years the chances of success are not

[1] The investigation reported here was made possible by a grant from the Commonwealth Fund, and was carried out under the guidance of Dr. Thorndike.

good . . . Entrance to this high school is pretty well barred to children who test much below 90 . . . In this high school, at least, the pupil with IQ below 90 is practically certain to fail in such studies as algebra and Latin . . . Below 90 IQ graduation is by no means likely."

Proctor (3), in connection with his study of the usefulness of intelligence tests in giving guidance to high school pupils, found on examination of the high school success of 107 freshman, that 70 per cent of those who tested below 95 in intelligence quotient on the Stanford-Binet Scale (19 pupils) failed in more than half of their subjects. All of this 70 per cent (13 pupils) either dropped out of school or repeated.

The annual report of the Providence Public Schools for the year 1917–1918 (4) contains similar information. In summary of the work in mental measurements of children, it gives in tables and in general statements the following information concerning the grammar schools:

The most usual mark of children whose intelligence quotients (Stanford-Binet Scale) are between 70 and 79 is *D* (conditioned), with more children failing (*E*) than passing (*C*). Only one child, among the 220 included in the table whose intelligence quotients were below 80, made a better mark than *C*. Among those whose intelligence quotients range from 80 to 89, the most usual mark is *C*, with more conditioned or failing than there are who do better than *C*. Among the group whose intelligence quotients range from 90 to 99, the most

TABLE I.—CORRELATION OF INTELLIGENCE AND SCHOOL WORK

IQ	Failed, *E*	Conditioned, *D*	Passing, *C*	Good, *B*	Excellent, *A*	Total	Distribution of intelligence
Below 70	27	36	4	...	..	67	0.055
70–80	36	92	24	1	..	153	0.15
80–90	8	71	125	21	2	227	0.223
90–100	1	22	133	40	3	199	0.195
100–110	1	10	67	77	15	170	0.167
110–120	..	4	23	66	23	116	0.114
120 and above	..	...	12	32	40	84	0.082
Total distribution, number.....	73	235	388	237	83	1016	
Marks, per cent.....	0 071	0.231	0 381	0.232	0.081		

frequent mark is still *C* but with rather more exceeding this than there are below it. Among the group from 100 to 109 there are more children making *A* and *B* than there are making grades below *B*. Above 109, no children fail and only 3½ per cent are conditioned, while most of them make *A* and *B*. (In connection with Table I it should be explained that it does not represent the Providence schools, since more of the backward than of the normal children were included.)

A second table in this same report includes an estimate as to the probable limit of successful school progress of children having different intelligence quotients. For comparison, Terman's estimates, from "The Measurement of Intelligence" (1), have been added to the table. (See Table II.)

TABLE II

IV	Mental age at 14	Probable limit of school progress	
		Providence estimate	Terman estimate
60–70	9-8	V*A*	IV*A*
70–80	11-2	VII*B*	VI*A*
80–90	12-6	VIII*B*	VIII*B*
90–100	14	VIII*A*	
100–110	15-4	VIII*A*	High school
110–120	16-8	VIII*A*	High school (average success)
120–150	18-2 (130) 19-6 (140) 21 (150)	First year high or more	

When the Providence figures are compared with the estimate given by Terman in "The Measurement of Intelligence" (1), it will be seen that the discrepancies are not very great, the estimates being identical at some points and never more than a year apart. The Providence table would seem to indicate that in order to do successful work in the first year of high school, an intelligence quotient of 120 is necessary. Terman would predict average high school success where the intelligence quotient is 110.

A third estimate is that of Supt. Carroll, who considers that an intelligence quotient of 110–115 is necessary for high school work.

These data obtainable this year have been chiefly in terms of the

Army Alpha Examination. In the following sections our figures will be expressed, so far as possible, both as Alpha scores, and in terms of the Stanford-Binet Scale. The following table, made up after a study of the Army (5), Kohs-Proctor (3), Kansas State Normal School (6), and Doll (7) norms, is the one which we have used, though naturally it is far from being considered final.

TABLE III

Median MA	Median Alpha score	Median MA	Median Alpha score
20-6	175	14-6	85
19-6	160	13-6	70
18-6	145	12-6	55
17-6	130	11-6	40
16-6	115	10-6	25
15-6	100	9-6	10

II. THE INTELLIGENCE OF HIGH SCHOOL PUPILS

The Army Alpha examination has been rather extensively used in high schools. In Kansas, the Bureau of Educational Measurements and Standards of the Kansas State Normal School at Emporia has collected data from a number of high schools (6). The medians from this survey are included in our tables and the distributions themselves (given by them in terms of letter grades) are similar to those here presented. Madsen and Sylvester (8) presented in "School and Society" in 1919 distributions obtained in three high schools in Illinois, Iowa and Wisconsin. The Bureau of Educational Reference and Research of the University of Michigan (9) issued in 1921 medians for some schools in that state; these schools[1] have cooperated by supplying their records for this study, and the distributions (see Tables IV–VII and Figure 1) are here given separately as well as in combination with Madsen's published figures.

Michigan may apparently be taken as fairly representative of the intelligence of the country as a whole. Reference to Section V will show that recruits from Michigan, and medical officers from Michigan, m de scores on Examination Alpha which were very slightly above

[1] Alma, Milan, Mt. Clemens, Mt. Pleasant and Detroit.

those of the country as a whole. While therefore it should be borne in mind that the group here reported is a local group, one will not go far amiss in generalizing its results.

Most striking is the wide variety of intelligence to be found in any one high school year. A freshman may score anything from 35, corresponding approximately to a mental age of 11 years, to 185, which is a very superior adult score. Few scores however (7 or 8 per cent) fall below 65 (MA about 13 years), and some of these are probably scores which are low through some accident. The median score of recruits to the National Army was 63 (MA about 13 years).

Whether the army was typical in intelligence of the total population of the United States is a question still under discussion. At both ends of the scale are groups in the general population which did not get into the army—at one end the feeble-minded, at the other, intelligent men exempted because of the importance of the work they were carrying on in civil life. Terman (10) believes that the recruits were on the whole lower than the whole population; Doll (7) and Goddard (11) consider the army a representative group. At any rate it is the best sample we have or are likely to have for some time of the intelligence of this country, and with the above cautions in mind, army figures will henceforward be used for reference as standing for the population as a whole. For this purpose officers in proper proportion[1] (see Figure 1) have been included with the recruits; the median for this total distribution is 65.

These results may well be compared with the Army figures (5), which indicate, in general, conditions which existed 10 years or more ago, both as to the proportion who continued in school and the stiffness of the requirements they had to meet. With this allowance, the Army figures are not widely discrepant from the results of Army Alpha given in schools of the present day. The difference which appears between the figures for recruits and those for officers shows up in a very interesting way the importance of the part which may be played by other personal qualities than intelligence in determining continuance in school and a commanding position in the world.

From these Army figures it appears that it was even more rare 10 years ago than it is today for a man with less than average Alpha score

[1] The proportion used was approximately one officer to 15 recruits. This is so small a proportion that the effect on the total distribution, while appreciable, is not great; it would have made no significant difference had the proportion used been 1 to 12, or 1 to 18 or 20.

TABLE IV.—ALPHA DISTRIBUTION OF HIGH SCHOOL FRESHMEN

Alpha score	Mt. Clemens	Milan	Mt. Pleasant	Alma	Mich. outside Detroit	Ill., Wis., and Ia.	Total, Ill., Wis., Ia., and Mich.	Per cent
205								
200								
195								
190								
185								
180	.....	.....	....	.....	.....	3	3	0.17
175	.....	.....	....	.....	.....	0	0	
170	.....	.....	....	.....	.....	2	2	0.12
165	1	.....	....	.....	1	2	3	0.17
160	.....	.....	1	1	2	5	7	0.41
155	.....	.....	....	.....	.....	7	7	0.41
150	.....	1	....	2	3	9	12	0.70
145	1	2	....	.....	3	13	16	0.93
140	1	.....	....	2	3	17	20	1.16
135	1	2	2	4	9	31	40	2.32
130	1	2	2	3	8	50	58	3.37
125	4	1	2	6	13	67	80	4.65
120	3	3	2	7	15	65	80	4.65
115	6	2	3	11	22	72	94	5.46
110	6	4	2	10	22	73	95	5.52
105	8	2	8	5	23	97	120	6.97
100	5	6	3	12	26	87	113	6.57
95	7	6	5	27	45	112	157	9.13
90	4	7	10	11	32	98	130	7.55
85	8	11	6	18	43	113	156	9.07
80	3	7	11	10	31	88	119	6.92
75	5	7	9	18	39	73	109	6.34
70	6	14	8	11	39	61	99	5.75
65	5	8	6	11	30	37	71	4.13
60	4	4	7	12	27	23	50	2.90
55	3	1	3	6	13	16	29	1.68
50	1	4	....	8	13	15	28	1.63
45	2	3	1	3	9	5	14	0.81
40	.....	1	....	.....	1	0	1	0.06
35	.....	1	....	1	2	4	6	0.35
30	.....	.....	....	.....	.....	0	0	
25	.....	.....	....	.....	.....	2	2	0.12
20								
15								
10								
No. cases	85	99	91	199	474	1247	1721	
Median....	96.07	84.64	85.4	90.68	88.84	98.95	96.48	
Median... MA.....	15-3	14-6	14-6	14-10	14-9	15-5	15-3	

TABLE V.—ALPHA DISTRIBUTION OF HIGH SCHOOL SOPHOMORES

Alpha score	Mt. Clemens	Milan	Mt. Pleasant	Alma	Mich. outside Detroit	Ill., Wis., and Ia.	Total, Ill., Wis., Ia , and Mich.	Per cent
205								
200								
195								
190								
185								
180	.....	....	.....	.....	.....	2	2	0.16
175	.....	....	.....	.....	.....	1	1	0.08
170	.....	....	.....	.....	.....	6	6	0.48
165	2	....	.....	.....	2	7	9	0.79
160	1	....	1	.....	2	7	9	0.79
155	.....	....	.....	2	2	15	17	1.36
150	.....	1	.....	1	2	20	22	1.76
145	4	....	1	4	9	30	39	3.11
140	4	....	.....	.....	4	47	51	4.07
135	.....	....	4	.....	4	34	38	3.03
130	6	2	4	.....	12	63	75	5.90
125	6	5	2	2	15	67	82	6.54
120	3	0	8	4	15	76	91	7.26
115	7	3	2	9	21	72	93	7.42
110	5	1	5	5	16	94	110	8.78
105	7	6	3	7	23	70	93	7.42
100	3	3	5	6	17	83	100	7.98
95	2	5	4	9	20	65	85	6.78
90	5	5	9	9	28	67	95	7.58
85	1	5	5	7	18	50	68	5.42
80	4	3	3	7	17	30	47	3.75
75	1	2	5	5	13	31	44	3.51
70	.....	1	2	3	6	22	28	2.23
65	.....	....	3	2	5	16	21	1.68
60	.....	....	2	3	5	8	13	1.04
55	.....	2	.....	2	4	1	5	0.40
50	.....	1	1	.....	2	3	5	0.40
45	.....	....	.....	.....	.....	2	2	0.16
40	.....	....	.....	.....	.....	0	0	.....
35	.....	....	.....	.....	.....	1	1	0.08
30						0	0	.....
25						0	0	.....
20						0	0	.....
15	.....	....	.....	.....	.....	1	1	0.08
No. cases	61	45	69	87	262	991	1253	
Median....	116.79	98.5	100.5	98.06	103.82	112.42	110.84	
Median ...								
MA.....	16-7	15-5	15-6	15-5	15-8	16-3	16-2	

TABLE VI.—ALPHA DISTRIBUTION OF HIGH SCHOOL JUNIORS

Alpha score	Mt. Clemens	Milan	Mt. Pleasant	Alma	Mich. outside Detroit	Ill., Wis., and Ia.	Total, Ill., Wis., Ia., and Mich.	Per cent
205								
200								
195								
190								
185	...	..	...	...	.....	2	2	0.20
180	...	..	1	...	1	3	4	0.41
175	...	..	...	2	2	5	7	0.72
170	2	..	1	...	3	8	11	1.13
165	1	..	2	...	3	15	18	1.84
160	1	..	...	...	1	15	16	1.64
155	4	..	2	1	7	32	39	3.99
150	2	..	2	...	4	38	42	4.30
145	2	..	2	3	7	34	41	4.20
140	2	..	4	4	10	51	61	6.24
135	1	..	2	5	8	60	68	6.96
130	3	..	...	3	6	62	68	6.96
125	4	1	4	1	10	66	76	7.78
120	5	..	3	2	10	74	84	8.60
115	5	..	7	4	16	76	92	9.41
110	3	..	2	6	11	68	79	8.09
105	3	..	3	2	8	52	60	6.14
100	3	1	3	3	10	48	58	5.94
95	1	1	2	7	11	42	53	5.42
90	1	..	3	2	6	23	29	2.97
85	1	..	1	4	6	19	25	2.56
80	...	..	1	3	4	13	17	1.74
75	1	..	1	2	4	7	11	1.13
70	...	..	...	3	3	3	6	0.61
65	...	..	...	1	1	3	4	0.41
60	...	..	...	2	2	0	2	0.20
55	1	..	...	2	3	0	3	0.31
50	...	..	...	...	.....	0	0	
45	...	..	...	...	.....	1	1	0.10
40								
35								
30								
25								
20								
No. cases	46	3	46	62	157	820	977	
Median...	124		120	110	117.97	123.72	122.89	
Median MA....	17-1		16-10	16-2	16-8	17-1	17-0	

TABLE VII.—ALPHA DISTRIBUTION OF HIGH SCHOOL SENIORS

Alpha score	Mt. Clemens	Milan	Mt. Pleasant	Alma	Mich. outside Detroit	Ill., Wis., Ia.	Total, Ill., Wis., Ia., and Mich., outside Detroit	Per cent	Detroit[1]	
									Number	Per cent
205										
200	.....	..	.....	.....	.....	1	1	0.13		
195	.....	..	.....	.....	.....	0	0			
190	.....	..	.....	.....	.....	2	2	0.26		
185	.....	..	.....	.....	.....	0	0			
180	1	..	.....	1	2	2	4	0.52	3	0.48
175	1	..	.....	.....	1	5	6	0.78	3	0.48
170	1	..	.....	1	2	12	14	1.83	11	1.77
165	.....	..	1	2	3	15	18	2.35	6	0.97
160	.....	..	2	1	3	18	21	2.74	17	2.74
155	1	..	3	3	7	31	38	4.96	19	3.06
150	2	..	2	3	7	26	33	4.30	30	4.83
145	.....	..	3	2	5	36	41	5.35	41	6.60
140	2	..	4	3	9	51	60	7.83	34	5.47
135	1	..	4	1	6	41	47	6.13	41	6.60
130	1	..	3	1	5	45	50	6.52	41	6.60
125	1	..	4	3	8	59	67	8.75	50	8.05
120	4	1	4	7	16	44	60	7.83	44	7.08
115	2	..	2	2	6	55	61	7.96	48	7.72
110	2	..	5	4	11	49	60	7.83	46	7.40
105	2	..	1	6	9	42	51	6.66	49	7.89
100	1	..	1	6	8	34	42	5.48	32	5.15
95	1	..	2	1	4	18	22	2.87	33	5.31
90	2	..	2	1	5	15	20	2.61	19	3.06
85	1	..	3	1	5	4	9	1.17	22	3.54
80	.....	..	.....	1	1	7	8	1.04	8	1.29
75	.....	..	2	3	5	15	20	2.61	11	1.77
70	1	..	.....	.....	1	3	4	0.52	4	0.64
65	.....	..	.....	1	1	3	4	0.52	3	0.48
60	.....	..	.....	.....	0	1	1	0.13	2	0.32
55	1	..	.....	.....	1	1	2	0.26	3	0.48
50	.....	..	.....	.....	.....	.....	.....	....	1	0.16
45										
40										
35										
30										
No. cases	28	1	48	54	131	635	766	....	621	
Median	121.25	..	127.5	120.71	122.66	127.25	126.42	....	123.35	
Median MA...	16-10	..	17-4	16-10	17-0	17-4	17-4	....	17-0	

[1]The median scores of the seniors in seven different high schools in Detroit were as follows:

SCHOOL	MEDIAN	MA	NO. CASES
Northeastern	115.0	16-6	108
Eastern	118.75	16-9	81
Southeastern	120.0	16-10	92
Central	123.33	17-0	114
Western	125.0	17-2	56
Northwestern	128.96	17-5	87
Northern	128.21	17-5	83

to have entered high school. High school pupils of that day, like present-day high school pupils, had at least average intelligence, as thus measured; in other words, the lower half of the population (in Alpha intelligence), practically without exception, had not continued in school beyond the elementary grades.

It will be seen then that in spite of the wide range of ability in high school freshmen, of which every high school teacher must be conscious, there are nevertheless few (less than 7½ per cent) who have not median intelligence or better, as measured by the Alpha examination. This corresponds approximately to a mental age of 13. The pupils in academic high schools are, in fact, a limited group, which just about covers the upper half of the whole range of American intelligence.

This is significant. Each year a larger and larger proportion of school children has been going on into high-school, until at present about half of the children who enter the first grade may be expected eventually to enter high school. (Local variations in this proportion are great. See Section V.) Since many of the more intelligent children still do not have the chance to go to high school, it will very soon be true that an appreciable per cent who are below average will be attempting the course. Thus the question of the degree of intelligence which is essential for success in the older academic course, and in the newer vocational courses (commercial, manual training, household economics, etc.) becomes of first-class importance.

III. Continuance in School in Relation to Intelligence

One way to get a very general look at this problem is to consider continuance in high school in relation to intelligence. It is obvious from the figures that sophomores do better than freshmen in the tests, juniors than sophomores, and seniors still better. Is this because the less intelligent pupils have found the way too hard, and have dropped out? Or is it be explained by the mental growth of the children, and the additional information and skill which they have acquired? We may grant at once that both causes are at work; improvement in scores (above what practice brings) appears when the same children are tested as freshmen, and again as seniors; while of a given freshmen class those who drop out before senior year are somewhat more largely from the lower than from the upper half of the distribution. (See Cobb and Tape in "School and Society"(12).) It is not yet

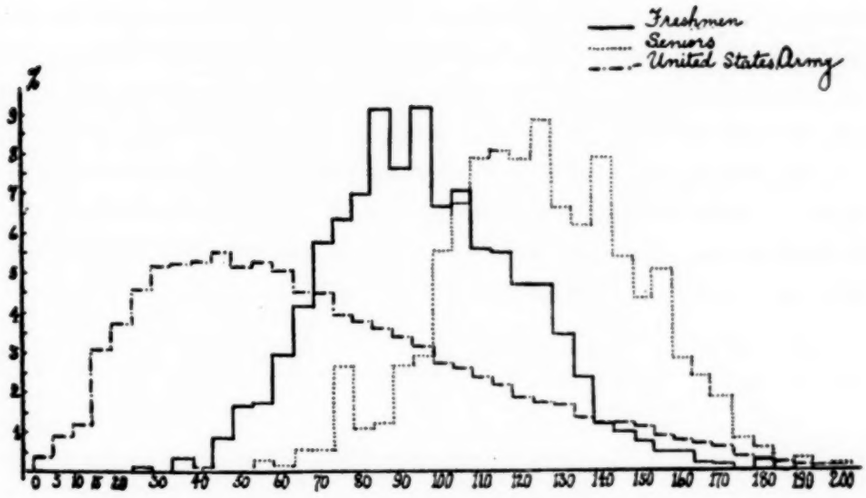

FIG. 1.—Distribution of Alpha scores of high school freshmen and high school seniors compared with Alpha scores of literate recruits and officers of the United States army.

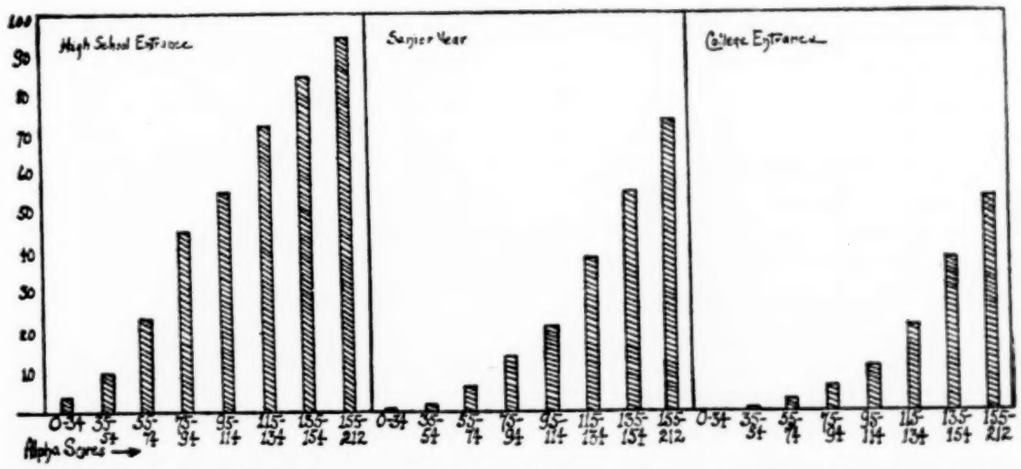

FIG. 2.—Per cent of recruits who had entered high school at different Alpha levels.

FIG. 3.—Per cent of recruits who had become high school seniors at different Alpha levels.

FIG. 4.—Per cent of recruits who had entered college at different Alpha levels.

possible to decide just how much of the yearly gain to ascribe to each of these factors. Growth, instruction and added experience are perhaps to be credited with more of it than is elimination of the less intelligent; but all we can say quite surely is that each plays an important part. This yearly gain, which is about 15 points at first, and decreases somewhat, is still found when high school seniors are compared with college freshmen. In Table VIII several college groups have been added for comparison; the gain is about 5 points.

TABLE VIII.—MEDIAN ALPHA SCORES, HIGH SCHOOL AND COLLEGE GROUPS

	Freshmen	Sophomores	Juniors	Seniors	College freshmen
Mt. Clemens	96.07	116.79	124.0	121.25	
Milan	84.64	98.5			
Mt. Pleasant	85.4	100.5	120.0	127.5	
Alma	90.68	98.06	110.0	120.71	
Michigan (outside Detroit)	89.05	103.82	117.97	122.6	
Illinois, Iowa and Missouri	98.95	112.42	123.72	127.25	
Illinois, Iowa, Missouri and Michigan	96.65	110.84	122.89	126.42	
Detroit	.....	.....	.....	123.35	
New York (Kansas report)	92.0	104.0	118.0	132.0	
Emporia, Kan	80.0	105.0	101.0	111.0	
Stanton, Va	91.0	114.5	136.0	117.0	
Kansas report	.....	.....	.....	.....	129.0
Ohio State University	.....	.....	.....	.....	130.0
University of Illinois	.....	.....	.....	.....	131.0
Oberlin College	.....	.....	.....	.....	148.4
Yale University	.....	.....	.....	.....	159.7
Recruits who had entered high school (tested 15 years out of school on the average)	97.76	104.61	111.36	115.06	118.7
Officers who had entered high school (tested 15 years out of school on the average)	140.68	141.34	141.97	142.55	143.3

This relation of intelligence to continuance in school may be brought out also in another way. The Army figures show very definitely that at the time these recruits were of high school and college age, say 5 to 10 years ago, the more intelligent youths all along the line

remained longer in school than those who made lower scores. Table IX shows the per cents entering high school, college, etc., at each Alpha level. Figure 2 illustrates the first column of this table, and shows the situation for high school freshmen. Of those scoring less than 35 on Alpha, 4 in 100 reported that they had entered high school; of those scoring 155 or better, 92 in 100, or 23 times as many, so reported. This comparison, based on Alpha scores, omits the illiterate group altogether. It is probable that, had they been included, the chance of entering high school would be at least 30 times as great for those over 155 as for those below 35.

TABLE IX.—PER CENT RECRUITS ENTERING HIGH SCHOOL, COLLEGE, ETC., AT VARIOUS ALPHA LEVELS

Alpha score	School continuance		
	Per cent entering high school	Per cent high school seniors	Per cent entering college
155 and above	93	73.0	53.0
135–154	84	55.0	39.0
115–134	72	38.0	21.0
95–114	55	22.0	11.0
75– 94	45	14.0	7.0
55– 74	23	6.0	3.0
35– 54	10	2.0	1.2
Below 35	4	0.7	0.3
Total	36	22.0	20.0

Figure 3, illustrating the second column of Table IX, shows similarly the proportions who reported that they became seniors and (practically all of them) graduated from high school. Of those scoring less than 35, less than 1 per cent, and of those scoring 155 or over, 73 per cent, reached the senior year in high school. Thus the chance of reaching this level is over 100 times as great for the highest as for the lowest group. Here again the contrast would be intensified had we had a comparable measure of the illiterate group, and included them.

Figure 4 shows comparable figures for entrance to college. A quarter of 1 per cent of the lowest group, and 53 per cent of the highest group, reported that they had entered college. The chance

of college entrance at that time appears to have been almost 200 times as good for those highly endowed intellectually as for the lowest fifth. Were illiterates included, the contrast would in this case also be strengthened.

This educational selection of intelligence is evidenced also in the large yearly increase in Alpha medians when the test is given throughout a school. Of course not the whole of this increase is due to elimination of the less intelligent pupils. To determine the exact amount which is due to this cause is at present impossible, but its existence is easily proved. Even the amount by which Alpha scores increase each year is not readily determined from data so sketchy as are these. The average figures from Table X are, from freshman to sophomore year, 15 points; from sophomore to junior year, 10 points; and from junior to senior year, 4 points. Fifteen points is approximately the amount by which, in the lower part of the scale, the score increases with an increase in *mental* age of 1 year. If 15 points up here is equivalent to 15 points lower down on the scale (which is quite problematical) then high school pupils, after the first year, are growing more slowly mentally than when they were younger.

The total increase from freshman to senior year may be estimated at about 30 points. Tables X and XI facilitate a comparison of Army figures with school figures, and an estimate of those elements which in the Army group were constant. Maturity, for instance, plays no part in the difference in the Army figures, for the men were all examined at the same time, after manhood was reached, instead of at different stages in the growth period; the separation into groups those who had left school as freshmen, sophomores, etc.—was made afterwards. Part of the effect of instruction also is not present in these Army differences—whatever part is temporary, and is afterwards forgotten and lost. But the groups of recruits do differ, and this remaining difference must be due to the effect of educational selection, and the more permanent effects of instruction. This remaining effect is strikingly less than the immediate effect of growth and instruction which we find in the groups examined year by year while in school. In general, it is not much over half as great. In other words, the indication is that mental maturity—mere mental growth, independent of environment—together with the temporary effects of instruction, is responsible for a good half of the change of score from freshman to sophomore year; from junior to senior year it accounts for about one-fifth of the change. Educational selection, and the permanent effects

of instruction, seem to account for nearly half of the increase from the first to the second year, and almost the whole of the yearly increase later on. Improvement in native intelligence, *i.e.*, inner development, or mental growth apart from instruction, is almost certainly still going on when these children enter high school. It is almost equally certain that very little of it goes on during their last year in high school.

TABLE X.—HIGH SCHOOL ALPHA SCORES

	Schools						Army	
	Mich.	Ill. Wis. and Ia.	N. Y. (Kan. report)	Emporia, Kan.	Stanton, Va.	Minn. survey	Recruits	Officers
Freshmen.....	88	99	92	80	91.0	93	98	140.7
Sophomores...	104	112	104	105	114.5	105	105	141.3
Juniors.....	118	124	118	101	136.0	111	111	142.0
Seniors.....	123	127	132	111	117.0	120	115	142.6

TABLE XI.—YEARLY INCREMENTS

	Schools						Army	
	Mich.	Ill. Wis. and Ia.	N. Y. (Kan. report)	Emporia, Kan.	Stanton, Va.	Minn. survey	Recruits	Officers
Freshman to sophomore..	16	13	12	25	21.5	12	7	0.7
Sophomore to junior.....	14	12	14	−4	21.5	6	6	0.7
Junior to senior.....	5	3	14	10	−19.0	9	4	0.6
Freshman to senior.....	35	28	40	31	24.0	27	17	2.0

In the officer group, maturity not only, but also selection and differences in amount of instruction are eliminated from the question, since very few men got into the officer group who had not had college training. Practically all of them are present in the group for each high school year, the drop in numbers being less than 3, 5 and 5 per cent for the three intervals. Accordingly, with none of the causes of

difference present, we should expect to find almost no difference in the Alpha scores. Actually, for each year interval the increase is less than one point Alpha score.

The influence of intelligence on continuance in school appears also when we look at the elimination which takes place among the freshmen of least intelligence. Since the facts from our previous tables indicate that a freshman who scores 77.5 will as a senior score about 90, we can get a rough notion of the extent of this elimination without necessarily following a freshman group all the way through. The assumption must be made that successive entering classes are of approximately the same size; then, we may compare the number in the freshman class who score below 77.5 with the number in the senior class who score below 90. Comparisons of this kind show that in the Michigan schools, 87 per cent of the freshmen below 77.5 drop out before senior year. In Madsen's group (Ill., Ia., and Wis.) about 84 per cent drop out. In general, at this Alpha level of intelligence, only about one in seven remains to graduate.

In the Army group, no adjustment between freshmen and senior scores needs to be made, since (as explained above) all the tests were made several years after the men left school. Here we find, among the recruits, that 78 per cent of those below 85 Alpha were eliminated. Among the officers, where the total elimination amounted to only about 10 per cent, 24 per cent of those scoring below 85 were nevertheless eliminated before senior year.

We have said that children who at 14 years of age score less than 60 to 65 on the Alpha examination are not likely to enter high school. Can we now, in summary, make a similar statement about the probability of graduation? Table VII shows that in the best high schools very few seniors score below 90 (MA about 15). We may estimate that this corresponds to a freshman score of 77.5 and can then say that not more than 1 freshman in 6 or 7 of those who as freshmen score below 77.5 (MA 14 years) remains to graduate.

(*To be Concluded in December.*)

THE PROBLEM OF GROUP INTELLIGENCE TESTS FOR VERY YOUNG CHILDREN[1]

R. PINTNER

AND

BESS V. CUNNINGHAM

Teachers College, Columbia University

The practical value of group intelligence tests for the better classification of school children is so great that a large number of such tests have appeared during the last 5 years. The easiest to construct and, therefore, the most numerous are the so-called verbal intelligence tests which involve a knowledge of reading and writing. These cannot be given to much advantage below Grade II. It is, however, precisely in Grade I and kindergarten that intelligence tests are of supreme importance, because in these grades the teachers have few or no measures of the children in school attainment upon which to base an estimate of their ability. Furthermore, it is of great practical value to group children as early as possible in relatively homogeneous groups, so that they may start their school career happily and properly adjusted.

A valuable list of the available group tests has been published by Whipple in "The Twenty-first Yearbook of the National Society for the Study of Education." In this book also there appears a good discussion of tests for the lower primary grades by Rogers. A comparative study of four of such tests has been made by Henmon and Streitz.[2] These authors conclude that there are no striking differences between three of the scales, and that while none of the three is a perfect measuring instrument, nevertheless each of them contributes valuable information as to the intelligence of the children measured.

It has been maintained by some that it is not possible, or at least not feasible, to test kindergarten children by means of the group method. They are supposed to be so independent and individualistic,

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[1] The tests described in this article are published by the World Book Company, Yonkers, N. Y., and are called "The Pintner-Cunningham Primary Mental Tests."

[2] Henmon, V. A. C., and Streitz, R.: A Comparative Study of Four Group Scales for the Primary Grades. *Journal of Educational Research*, Vol. V, No. 3, March, 1922, pp. 185–194.

so little amenable to group control, as to make impossible the giving of a group test. It is certainly true that children at this level are independent and individualistic and, in addition, little habituated to follow directions and commands given to them as a group. The more modern or less formal the kindergarten is, the less practiced are they in group work. This does not mean, however, that group tests are, therefore, impossible. It means rather that the psychologist must make his tests of such intrinsic interest to the child as to compel his attention, so to devise them as to make the child feel that he is playing a very special game along with his fellows. Under such conditions the size of the group that can be handled by one examiner will depend upon the skill of the examiner in dealing with young children and upon the number of assistants that may be available. It has been the experience of the writers to find it perfectly feasible for one examiner without assistance to test as many as 25 kindergarten children at one time. It may not be desirable in general to do this, and it may be good policy in most cases to restrict the group to about fifteen children.

In the construction of a suitable kindergarten and Grade I test, there are certain necessary prerequisites. The test should contain no letters or numbers. Although some children in Grade I and even in the kindergarten are familiar with numbers and with some letters or even words, the vast majority are not; and the introduction of such material will tend to convert the test into an achievement test rather than a test of native ability. Furthermore, the responses required of the child must not involve the writing of conventional signs, such as letters or figures. Only the simplest kind of response with a pencil or crayon should be demanded and, if possible, this response should be uniform, or nearly so, throughout the test. In the tests we have constructed the child responds by marking something and the mark in each case is a simple line drawn on a picture or element of the test. The one exception to this is the dot drawing test in which the child has to draw a line from one dot to another as in the copy before him.

In 1920, a first set of tests was constructed consisting of five exercises: (1) Recognition of common objects used in various situations; (2) the finding of isolated parts of a picture; (3) the connecting of dots so as to copy a given simple picture; (4) checking the pictures described in a story told to the children. These tests were given to about one hundred children ranging in age from 4½ to 7 years. A careful analysis of the results of each element in each exercise was made.

In addition correlations with the Binet, Dearborn, Detroit, Kingsbury and Pressey were computed. The coefficients ranged from 72 with the Binet to 49 with the Detroit.

Four more exercises were then constructed as follows: (1) æsthetic differences, *i.e.*, marking the prettiest of three similar objects; (2) marking two associated objects in a series of four objects; (3) drawing completion; (4) marking the shortest distance between two given points, a sort of simplified maze test. A minute analysis of these various tests and the elements of each was again made. As a result of this, several changes were made and a few of the tests omitted. The tests were then tried out on six first grades and a further analysis of the results made.

On the basis of this experience a preliminary edition of the tests was printed. This First Revision consisted of a booklet of eight pages measuring $8\frac{1}{2} \times 11$ inches, that is, the conventional size for test blanks. There were six exercises as follows:

Page 2—Common Observation—5 elements;
Page 3—Æsthetic Differences—6 elements;
Pages 4 and 5—Picture Parts—8 elements;
Page 6—Associated Objects—7 elements;
Page 7—Picture Completion—12 elements;
Page 8—Dot Drawing—12 elements.

In each exercise the elements progressed from easy to harder ones. Rather extensive trials with this edition showed that the test discriminated well between ages 5, 6 and 7, and fairly well between the half age intervals. The correlation of the test scores with Binet mental ages of 18 cases, ranging in chronological age from 5-1 to 7-11 was 0.87. The correlations of the same cases with each of the separate tests of the group ranged from 0.60 to 0.76. A correlation of 27 cases of superior 7- and 8-year-olds, who were in Grades III and IV, between the Binet and the test scores showed a correlation of only 0.48, revealing a deficiency in discriminating capacity for brighter children. The rank correlation between Binet and test score of 33 children, mostly foreign, in a special school, ranging in MA from 7 to 9-6 and in IQ from 46 to 87, was 0.46.

A number of cases tested on the Binet Scale showed the following average scores for the mental ages of feebleminded and bright children:

Mental age	Feebleminded		Bright	
	n	Score	*n*	Score
8-0–8-5	14	54	5	54
7-6–7-11	16	47	3	46
7-0–7-5	18	36	5	42
6-5–6-11	9	31	3	28

On the basis of this experience with the test certain changes were now made. The large page of the test blank measuring 8½ by 11 inches was abandoned and a small page measuring 6 by 9½ inches was substituted. This change was felt to be particularly desirable for the kindergarten children. Through the cooperation of Professor Patty Hill of Teachers College, Columbia, the youngest kindergarten children of the Horace Mann School were examined individually. Actual experience in watching these younger children perform the test individually, listening to their remarks and questioning them at times showed a marked tendency for them to be distracted by the relatively large number of pictures on the large page.

They found great difficulty in keeping their attention on the item under consideration at any one time.[1] Several items of about the same difficulty were omitted and in their places a few harder and easier items substituted. The picture completion test was so constructed as to avoid the necessity for the child to draw in the missing part. This was accomplished by presenting several parts near the incomplete picture, one of which had to be marked. A new test, called discrimination of size, was added. This presents a doll and the child has to choose from three dresses, hats, shoes, gloves, the one that will best fit the doll. In addition several minor changes in arrangement and spacing were made in order to help the young child keep his attention on the item under consideration.

In the final edition of the test, therefore, we have a booklet of 16 pages measuring 6 by 9½ inches. The first page is for the name, age and other necessary data as well as for a record of the scores. No

[1] Cf. Rogers, A. H.: Measurement of the Abilities and Achievements of Children in the Lower Primary Grades. *The Twenty-first Yearbook of the National Society for the Study of Education*, 1922, pp. 143–151.

page contains more than four items of a test and several contain only one or two. In this form it has been given to about one thousand children, between the ages of 4 to 8, and has been found to work very well. The problem of turning over the pages is greater in the new form than in the old, but the children quickly become adapted to it with a little help and guidance. With the small page the common tendency of the young child to be distracted by the numerous pictures is very much reduced. Time limits for each exercise have been set, not with the idea of making the test a speed test, but to insure that it shall be given to all alike under standard conditions.

Some of the correlations of this test with other tests are as follows:

Test	Cases	Grade	Correlation
Binet	19	Grade I children	0.82
Binet	20	Kindergarten children	0.71
Binet	17	Kindergarten children	0.55
Binet	105	Kindergarten and Grade I children	0.77
Kingsbury	74	Grade I and Grade II children	0.56
Otis Primary	39	Grade II children	0.66
Otis Primary	36	Kindergarten children	0.66
Teachers' ranking	19	Grade I children	0.78
Teachers' ranking	26	Grade II children	0.64
Teachers' ranking	36	Kindergarten children	0.78

In a survey of two schools under the direction of Dr. McCall of Teachers College this test was used. A composite rating based upon the teachers' rating—the Otis in one case, the Kingsbury in the other; and our own test—was devised. This composite rating was made for practical purposes in the survey and not for a measure of our test. The following are correlations of our test with this composite:

Grade II	= 0.78	26 cases
Grade II	= 0.79	39 cases
Grade I	= 0.81	44 cases
Kindergarten	= 0.83	36 cases

With two groups of children the test was repeated after an interval of one day to measure its reliability. The correlations of the first with the second trial are:

17 Kindergarten children	0.88
20 Kindergarten children	0.96

A distribution of the scores for each half age and for each age from 4 to 8 has been made, and percentile scores computed. The median scores are shown below:

FOR HALF YEAR INTERVALS

AGE	MEDIAN	N
4-0–4-5	10	7
4-6–4-11	13	34
5-0–5-5	15	79
5-6–5-11	18	148
6-0–6-5	24	234
6-6–6-11	28	212
7-0–7-5	34	176
7-6–7-11	39	92
8-0–8-5	42	50
8-6–8-11	38	23
Total		1055

FOR WHOLE YEAR INTERVALS

AGE	MEDIAN	N
4	12	41
5	18	227
6	26	446
7	36	268
8	40	73
Total		1055

Figure 1 shows the percentile curves for ages 4, 5, 6, 7 and 8. The actual percentile points calculated are shown on the base line. These curves show a discrimination at all percentile points except in two cases at the 0 and 100 points. Our sampling of age 8 is probably not so good as the samplings at the other ages. Similar percentile curves for the half ages have been constructed. These naturally do not show such a good discrimination as for the whole ages.

A percentage distribution of the scores according to half ages is given in Table I, and according to whole ages in Table II. Frequency curves of these distributions have been constructed but are not reproduced here, since the main facts can be gathered from the tables and the percentile curves, and they do not add anything of material importance.

Our norms are by no means adequate at the present time. The median for age four is in all probability too high, and the median for age eight is probably rather low. These norms, therefore, must be

regarded as merely suggestive. In the near future it is hoped that more adequate norms will be available. In the meantime, however, the test may be of use in classification of children. The correlations with other tests and with teachers' ratings are on the whole fairly high. The test should prove of decided value in practical work for the classification of kindergarten and Grade I children.

The practical value of the test was demonstrated by an experiment in classification of Grade I children in Newton School, Toledo, Ohio. The Grade I children were all tested at the beginning of the school year by means of the first printed edition of the Pintner-Cunningham

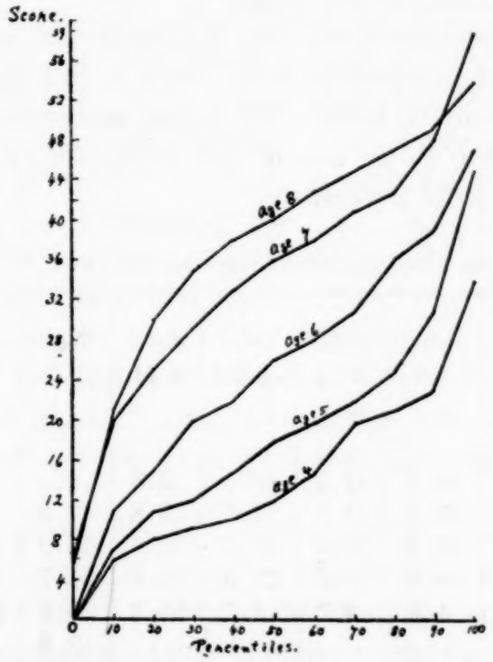

FIG. 1.—Percentile curves for ages 4 to 8.

Tests. Upon the basis of test results the children were placed in three rooms—the ones making high scores upon the tests in one room, those making average scores in another and those making poor scores in still another. The complete results of the study can be determined only by the use of further tests, but the regular reports of principal and teachers indicate that the experiment has been highly successful. There have been no failures in promotion in either the bright or the average groups. Bright and slow children have profited equally by the division of the classes into groups as nearly homogeneous as possible. The bright children have covered 2 years work in 1 year in some cases. While the advisability of rapid advance as an aim

is not fully established, the results at least prove the need for devising some means of better meeting individual needs in the schoolroom. Children are happier when working neither too far beyond nor too far under their maximum capacities. The use of group mental tests can at least help in classification.

The mental test measures only one phase of activity. Within a year a companion series to the mental test is to be published. The aim of the combined series is to test achievement in responses which may be taught upon a basis of native capacity to learn. Beginning reading, number work, drawing, and a knowledge of right social relations are to be included in the series.

Group tests can best serve the kindergarten and primary child and teacher if used sympathetically, with a full appreciation of the fact that they aim only to help in the better understanding of the needs of each child and are to be considered as guides rather than as conclusive evidence of final procedure.

TABLE I.—PERCENTAGE DISTRIBUTION OF SCORES FOR HALF-AGE INTERVALS

Scores	4-0–4-5	4-6–4-11	5-0–5-5	5-6–5-11	6-0–6-5	6-6–6-11	7-0–7-5	7-6–7-11	8-0–8-5	8-6–8-11
0–9	28.6	29.4	16.5	12.2	13.5	3.8	....	1.1	2.0	4.3
10–19	42.8	38.2	45.5	43.3	21.4	19.8	7.4	6.5	6.0	4.3
20–29	28.6	29.4	31.6	32.5	35.1	34.9	26.2	15.2	10.0	13.0
30–39	....	2.9	5.1	11.5	25.6	26.4	34.7	30.4	28.0	34.8
40–49	....	....	1.3	0.7	4.7	15.2	29.0	39.1	46.0	43.5
50–59	....	....	....	....	....	....	2.8	7.6	8.0	

TABLE II.—PERCENTAGE DISTRIBUTION OF SCORES FOR YEAR INTERVALS

Scores	4	5	6	7	8
0–9	29.3	13.6	8.7	0.4	2.7
10–19	39.0	44.0	20.6	7.1	5.5
20–29	29.3	32.0	34.9	22.4	11.0
30–39	2.4	9.3	25.9	33.2	30.2
40–49	....	0.9	9.6	32.6	45.2
50–59	....	....	....	4.5	5.5

A NEW TIMING DEVICE FOR "WORK LIMIT" GROUP TESTS

BENJ. W. ROBINSON

Bureau of Personnel Research, Carnegie Institute of Technology

The giving of group tests in which each individual is allowed to complete the entire test, has been hampered by the difficulty involved in ascertaining the time consumed by each individual. This difficulty was met recently in an investigation carried on to discover a team of tests that would select talent for prospective comptometer operators. Included in this group of tests was the Woodworth-Wells Hard Directions Test.[1] Since it was apparent that a wider range of individual differences would probably be revealed if the test was given by the "work limit" method, the problem became the devising of apparatus for measuring the time used by each individual. Accordingly the device shown in the accompanying cut was developed.

This device is simple and inexpensive. It consists of a board ¾ by 6 by 12 inches, 31 cards 4 by 5 inches, and 24 inches of heavy wire. The cards are numbered from 0 to 30. The numbers are 3 inches high so that they are easily visible. A "Graffco" Vise Signal was placed on each card so that the card might be easily manipulated.

In the series used, the Woodworth-Wells Easy Directions Test was given as a "shock absorber." One minute and twenty seconds was the time allowed. Then mimeographed copies of the Hard Directions Test were passed out face down upon the desks. The subjects were told that this was another set of directions which they were to follow, doing just what they were told to do and nothing more. At the end of the standard form of this test had been added the following directions: "After finishing all of the above directions, look at the number displayed at the front of the room. Write it on this line ——, then hold up your paper to be collected."

As soon as the subjects had been told to turn over their papers and follow directions, the starting time was noted. Then the examiner's assistant placed the timing device in full view on a desk in the front of the room, with O showing. When the first paper was held

[1] Woodworth, R. S., and Wells, L. W.: Association Tests. *Psychological Monographs*, Vol. XIII, No. 5, Dec., 1911, p. 72.

up to be collected the time was again noted. Then each 5 seconds thereafter a card was dropped forward disclosing a new number.

The examiner and the instructor of the class in comptometry collected the test papers, being careful to see that the number written in was that then showing or the one just preceding, for it might happen that a paper would be held up just as the number was changed.

The first paper held up was marked O for it established the constant, which was the time that elapsed between the start of the test and the finishing by the first individual. In this case the constant was 100 seconds. The second paper held up was marked I which indicates that the individual finished in from 100 to 105 seconds. The constant plus five times the number written at the bottom of the page gives within 5 seconds of the time required to complete the test.

The accompanying chart shows how the time was distributed

among the 33 students taking the test. The range of the distribution is from 100 to 250 seconds in which 22 of the possible 31 steps are occupied. This is a more sensitive method of revealing individual differences than would have been possible had the test been given by the "time limit" method. The best possible score under that method would have been 16, which would admit of a range of O to 16, in the most extreme instance, or only about one-half the number of units of range obtained under the "work limit" method.

This timing device may be used with varying units of time between the changing of cards, or the number of cards may be increased, thus admitting of its use with tests requiring widely different amounts of

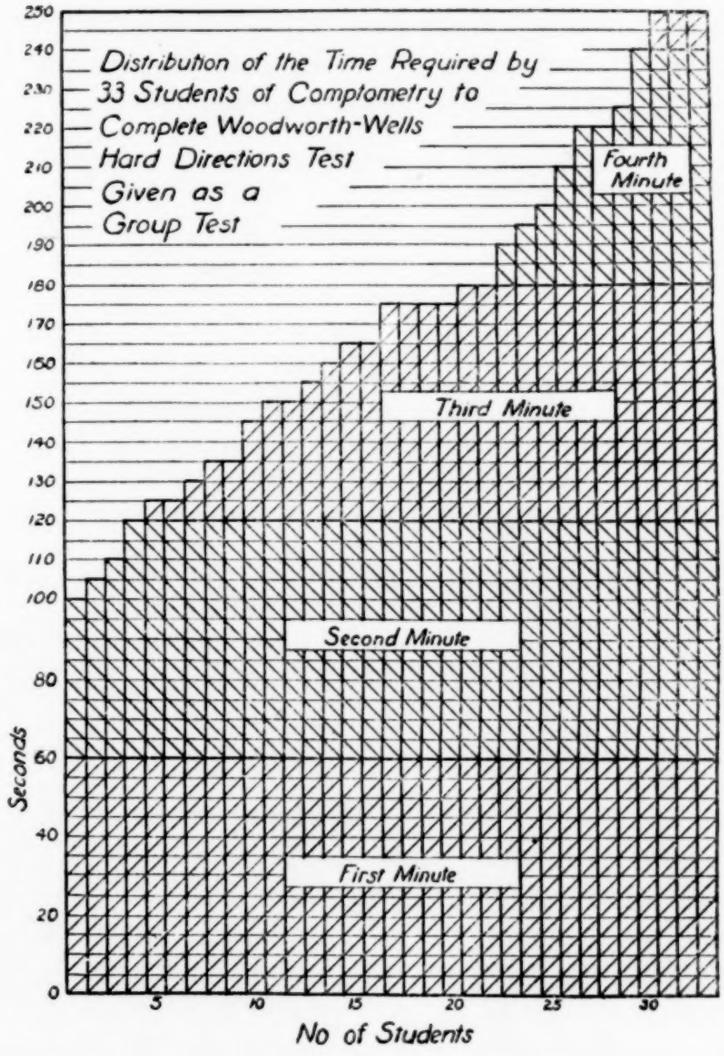

CHART I.

time. Another use has been suggested but to date no opportunity to try it out has arisen. That is its use—to obtain not only the total time required but subdivisions of the whole. Where several tests have been bound together to be given under the "work limit" method, a note at the bottom of each test instructing that the number on display be noted before the subject proceed to the next test, would result in a series of numbers from which the time consumed by each individual test could be estimated fairly accurately, and the total time could be checked as accurately as was done in the present study.

THE EFFECTIVENESS OF ORAL VERSUS SILENT READING IN THE INITIAL MEMORIZATION OF POEMS

CLIFFORD WOODY

University of Michigan

This report embodies the results of an experiment directed by the writer in his class in Experimental Education at the University of Washington during the first quarter of the 1920–21 year. It represents a definite attempt to throw some light on the question as to whether it is better to commit to memory by reading aloud or by reading silently. The experiment consisted in having 17 subjects, 15 juniors and seniors and 2 graduate students, memorize five pairs of poems. One poem of each pair was memorized by means of oral reading, and the other poem by means of silent reading.

TABLE I.—POEMS OR PARTS OF POEMS MEMORIZED

Pair		Author	Title	Number of lines
Pair I	*A*.....	Wordsworth	Lucy Poem	12
	B.....	Wordsworth	Lucy Poem	12
Pair II	*A*.....	Riley	The Days Gone By	18
	B.....	Riley	When My Dreams Come True	18
Pair III	*A*.....	Byron	Mazeppa's Ride	48
	B.....	Byron	The Prisoner of Chillon	48
Pair IV	*A*.....	Shakespeare	Sonnet	14
	B.....	Shakespeare	Sonnet	14
Pair V	*A*.....	Browning	Abt Vogler	24
	B.....	Browning	Abt Vogler	24

The poems learned as presented in Table I represent a great variety of material. Some of them are short and easy with pronounced rhythm and rhyme while others are longer and more abstract with a more dignified meter. However, the two poems of each pair have the same rhythm, length of line, quality of language, and consequently, the same approximate difficulty. None of the students were sufficiently familiar with the poems to destroy the difficulty of the pairs.

Method Pursued

In order to distribute whatever improvement might accure from the memorization of the first poem of a pair, one group of subjects learned poem *A* orally and then poem *B* silently while the other group learned poem *B* silently and poem *A* orally. Furthermore, each additional pair of poems was learned in the reverse order of the preceding pair. It should also be stated that part of each group learned poem *A* orally while the other part learned poem *B* orally. Thus if any difference existed in the difficulty of the two poems of a pair, its influence was neutralized.

Table II exhibiting the order of learning the different poems shows that nine subjects learned poem *A* of pair I orally and then

Table II.—Number of Individuals Using the Indicated Orders of Learning the Poems

	A—Orally first *B*—Silently second	*A*—Orally second *B*—Silently first	*B*—Orally first *A*—Silently second	*B*—Orally second *A*—Silently first
Pair I	9	5	1	2
Pair II	3	2	4	8
Pair III	8	5	1	3
Pair IV	5	0	6	6
Pair V	7	3	2	5

learned poem *B* silently; five subjects learned poem *B* silently and then learned poem *A* orally; one subject learned poem *B* orally and then poem *A* silently; two subjects learned poem *A* silently and then learned poem *B* orally. The facts for the other pairs are interpreted in the same manner.

In memorizing all pairs save pair V, the subjects were instructed to read the poem through without stopping, then to return to the first line, and to repeat the process until the poem was learned so that it could be reproduced without hesitation or error. They were instructed to test their learning at intervals by beginning at the first of the poem and reproducing as much of it as possible. When reproduction became impossible they were to begin reading and to continue as outlined above until another testing was desired. In learning pair V the subjects were told to use any method they preferred.

The effectiveness of the two methods of learning was determined by the amount of time and the number of repetitions required for memorization. In case of pair V only the amount of time consumed was considered.

Results

Table III shows that less time was consumed with oral memorization in all pairs of poems save pair V and here silent memorization consumed less time. It seemed that the less time used in the

Table III.—Minutes Consumed and Repetitions Required in Initial Learning of Different Pairs of Poems by the Oral and Silent Methods

Method	Pair I		Pair II		Pair III		Pair IV		Pair V	
	Minute	Repetition	Minute	Repetition	Minute	Repetition	Minute	Repetition	Minute	Repetition
Silent.....	230	181	329	211	1087	368	328	238	761	
Oral.....	204	188	246	187	891	311	308	254	790	

memorization of pair V with the silent method might be due to the subjects having followed their own methods in learning this pair, but investigation showed that few subjects had made any changes in method and that these were not the ones responsible for the result. The table also reveals that fewer repetitions were required with the oral method in pairs II and III; with the silent method, in pairs I and IV. On the basis of the gross number of repetitions required the superiority of the oral method is not as marked as on the basis of time consumed. This indicates the necessity of considering both factors in the proper evaluation of the efficiency of the methods.

Before leaving this table it should be pointed out that there is considerable evidence that the subjects read faster orally than silently. This tendency is clearly manifest in case of pairs I and IV where less time was consumed but more repetitions were made. Usually the rate for adults is much greater in silent than in oral reading. Upon being questioned concerning their behavior with the two methods the subjects reported that the mere rhythm and pronunciation of the words in the oral reading kept them reading ahead, but that they had to exercise constant effort in silent reading to keep from re-reading certain more or less obscure portions. Furthermore, they reported that the knowledge that they had to reproduce the poem retarded

their silent reading very greatly, but did not have much influence on their oral reading. While these reactions are purely subjective they are very similar to the findings of C. T. Gray[1] and probably account for the greater speed in the oral reading. At the same time, they may have a definite bearing on the greater efficiency of the oral method.

The superiority of the oral method as indicated by the gross results in Table III is more clearly seen in Table IV which shows that a big majority of the subjects consumed less time and required fewer repetitions with the oral method in learning the poems of the different pairs. A few subjects consumed less time and required fewer repetitions with the silent learning in each pair of poems and a majority of

TABLE IV.—INDIVIDUALS CONSUMING LESS TIME OR MAKING FEWER REPETITIONS WITH THE DIFFERENT METHODS OF LEARNING

	Pair I	Pair II	Pair III	Pair IV	Pair V
Less time silently	5	5	2	7	11
Less time orally	12	11	15	8	6
Same time with each method	0	1	0	2	0
Fewer repetitions silently	6	6	2	5	
Fewer repetitions orally	10	7	15	10	
Same number repetitions with each	1	4	0	2	

the subjects consumed less time in pair V. This raises the question as to whether the methods are equally adaptable to the different subjects and to the different poems.

Tables V and VI show that few individual subjects have persistent success with either method. Only three subjects consumed less time in all five pairs of poems with a single method. Similarly only three subjects made fewer repetitions in all four pairs with a single method. In each case the single method was the oral method. None of the other subjects either on the basis of time consumed or repetitions required performed constantly with either method, but there was a tendency for more constant success with the oral method. Twelve subjects consumed less time in three or more pairs with the oral method

[1] Gray, C. T.: Types of Reading Ability as Exhibited through Tests and Laboratory Experiments. *Supplementary Educational Monographs*, Vol. I, No. 5, University of Chicago Press.

TABLE V.[1]—EXTENT TO WHICH SUBJECTS CONSTANTLY CONSUMED LESS TIME WITH ONE METHOD IN THE MEMORIZATION OF THE FIVE PAIRS OF POEMS

5—Oral 0—Silent	4—Oral 1—Silent	3—Oral 2—Silent	2—Oral 3—Silent	1—Oral 4—Silent	0—Oral 4—Silent 1—Same	3—Oral 1—Silent 1—Same	2—Oral 2—Silent 1—Same
3	3	5	1	2	1	1	1

while only four subjects consumed less time with three or more pairs with the silent method. Ten subjects required fewer repetitions with

TABLE VI.—EXTENT TO WHICH SUBJECTS CONSTANTLY MADE FEWER REPETITIONS WITH ONE METHOD IN THE MEMORIZATION OF THE FOUR PAIRS OF POEMS

4—Oral 0—Silent	3—Oral 1—Silent	2—Oral 2—Silent	1—Oral 3—Silent	3—Oral 0—Silent	1—Oral 2—Silent	1—Oral 1—Silent
3	5	3	2	2	1	1

the oral method in at least three of the four pairs while only two subjects required fewer repetitions with the silent method in as many as three pairs. When both time consumption and repetitions were considered together, there were eleven subjects who excelled with the oral method in a majority of the pairs of poems.

TABLE VII.—SUMMARY OF COEFFICIENTS OF CORRELATION BETWEEN FACTORS IN THE INDIVIDUAL PAIRS OF POEMS

	Pair I	Pair II	Pair III	Pair IV	Pair V	Average
Time consumed silently and orally...	0.81	0.93	0.93	0.65	0.50	0.76
Repetitions required silently and orally.....	0.75	0.83	0.79	0.56	....	0.73
Time consumed orally and repetitions.....	0.58	0.66	0.80	0.82	....	0.71
Time consumed silently and repetions.....	0.74	0.62	0.70	0.72	....	0.69

[1] Note: Read as follows: Three subjects consumed less time with the oral method in five pairs of poems; three subjects, in four pairs of poems with the oral method and in one pair with the silent method; etc.

TABLE VIII.—CORRELATIONS BETWEEN MINUTES CONSUMED IN LEARNING THE DIFFERENT POEMS IN EACH PAIR BY THE SILENT METHOD

	Pair II	Pair III	Pair IV	Pair V
Pair I	0.76	0.77	0.68	0.48
Pair II	....	0.34	0.63	0.63
Pair III	....	....	0.76	0.52
Pair IV	....	....	....	0.08

TABLE IX.—CORRELATIONS BETWEEN MINUTES CONSUMED IN LEARNING THE DIFFERENT POEMS IN EACH PAIR BY THE ORAL METHOD

	Pair II	Pair III	Pair IV	Pair V
Pair I	0.56	0.70	0.88	0.21
Pair II	....	0.52	0.56	0.35
Pair III	....	....	0.89	0.29
Pair IV	....	....	....	0.33

A survey of the coefficients of correlation (Spearman's Method of Rank-difference) furnishes more evidence of the general superiority of the oral method. Those subjects who did well with the oral method did well with the silent method also. This fact refutes the contention that there is one type of mind which succeeds with one method and another type of mind which succeeds with another method. Furthermore, those subjects who did well in memorizing the poem of one pair with either method also did well in memorizing the poems of the other pairs with the same method. This signifies that the methods tend to be equally applicable to the different pairs of poems. It also signifies that the two poems of the different pairs are approximately equal in difficulty. The lower correlations in which pair V is involved suggest that the poems of this pair were not of equal difficulty for all subjects. Investigation revealed that three subjects were slightly familiar with one or the other of the poems in this pair. This fact would account for the lower correlations with pair V, but since these subjects were not all familiar with the same poem and since they did not all employ the same method in learning the poems possessing familiarity, it isn't probable that the general results were influenced.

Summary

From this investigation, the following points seem reasonably clear:

1. That less time was usually consumed in memorization by means of oral reading.

2. That memorization through silent reading tended to be more efficient for a few individuals.

3. That there was little difference in the number of repetitions required by the silent and oral methods. There was some evidence that reading poems is quite different from ordinary silent reading.

4. That the oral method was superior with a majority of the subjects in a majority of the pairs of poems.

5. That the individuals who consumed little time in learning by the silent method also consumed little time by the oral method, and that the ones who made few repetitions with one method made few repetitions with the other method.

6. That the individuals who consumed little time or made few repetitions in learning one pair of poems tended to consume little time and to make few repetitions in learning the other pairs.

7. That these conclusions apply only to the initial memorization of poems and that further experimentation is needed to establish their application for permanent retention.

THE CONSTANCY OF INTELLIGENCE QUOTIENTS (A CASE STUDY)

EDWARD A. LINCOLN

Psycho-Educational Clinic, Harvard University

There is a tendency, found not only in the ranks of laymen but among students as well, to assume that once the existence of a law of nature has been established its subsequent workings will proceed with absolute mathematical regularity. The experimenter in the laboratory knows this conception to be false. He sees that doubling the pressure on a body of gas does not always reduce it to exactly half its previous volume. He finds that not all analyses of its compounds will show precisely the same atomic weight for oxygen. He gets approximations, but seldom finds exactitude to the last decimal place. Indeed, proper scientific method, whether used in determining the length of a block or the composition of a chemical compound, demands that the average of a number of repeated measurements be taken. It is also well known to the expert that infinite pains must be taken if similar experiments are to give like results. A slight impurity in a solution will prevent a desired reaction. Too little washing of a precipitate or a poorly adjusted balance will spoil an analysis. In short, conditions must be identical, or not even approximately similar results may be expected.

These facts are too often forgotten by those who argue about the constancy of Intelligence Quotients. It has not yet been demonstrated what "constancy" really is. No one knows how much or how little the performance of a subject would vary if he were given two examinations on the same morning, or on successive days. It seems altogether likely that, if real scientific method is to be followed, no definite classification should be made on the basis of one examination alone, but that a number of Intelligence Quotients should be obtained and averaged for each individual. As for maintaining identical conditions, this seems quite impossible in the measurement of intelligence. The mere fact that a subject has been examined once precludes the possibility of making the conditions the same, and when to this is added the lapse of considerable time between testings, during which the individual undergoes many experiences, it will be seen that we have departed far from an ideal of scientific procedure.

These considerations lead to the conclusion that some discrepancies between successive intelligence quotients may be set down as the

result of the lack of scientific method. Those who believe that Intelligence Quotients are essentially constant have generally explained large differences as due either to some technical fault in the measuring instruments which were used, or to lack of uniformity in the technique of administering or scoring the tests. It is possible, however, that the differences may not be the results of any of these causes, but that they appear in some instances as indicating real changes in the individual which are not necessarily changes in native intelligence. It is the purpose of this paper to study some subjects in whose Intelligence

TABLE I.—INTELLIGENCE QUOTIENTS OF SUMMER SCHOOL PUPILS

	Age at first test	1918	1919	1920	1921	Greatest difference
1	7- 7	97	98	102	96	6
2	9- 2	124	124	...	128	4
3	5- 9	99	101	95	109	14
4	8- 1	...	102	108	...	6
5	14- 4	...	101	106	...	5
6	10- 6	...	115	115	...	0
7	9- 0	98	98	...	...	0
8	9- 7	...	...	98	87	11
9	14- 1	...	...	110	115	5
10	11- 8	...	...	140	138	2
11	10- 9	...	...	94	94	0
12	6- 5	88	...	...	88	0
13	7- 8	100	...	98	97	3
14	10- 7	107	111	...	...	4
15	11- 2	95	101	103	107	12
16	9-11	99	112	118	136	37
17	9- 0	108	102	...	...	6
18	13- 2	120	123	...	...	3
19	8- 1	89	90	...	87	3
20	6-11	111	...	...	111	0
21	7- 4	124	124	124	128	4
22	2- 8	138	...	125	119	19
23	9- 0	...	85	102	100	17
24	8- 6	114	112	...	124	12
25	10- 5	124	131	136	...	12
26	6- 1	147	144	166	167	23
27	11- 4	...	146	138	...	8

Quotients wide variations appear, and to find, if possible, the reasons for these changes.[1]

The cases first to be considered are shown in Table I. The children were examined in a summer school during the years 1918 to 1921 inclusive. During the first two summers resident psychologists examined the children with the Stanford-Binet Scale and obtained considerable supplementary information. In 1920 and 1921 psychological examiners visited the school long enough to give all the children individual and group examinations. Each year the teachers in the school recorded in weekly reports their impressions regarding various phases of each child's activities. Thus there were available for this study not only the results of the tests but many other data as well.

It will be seen, in the first place, that there is in the results of these repeated tests considerable evidence for the constancy of the Intelligence Quotients. When all possible comparisons are made, that is when each IQ of an individual is compared with all other IQ's of the same individual obtained throughout the 4 years of testing, the distribution of the differences is found to be as follows:

Difference..	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
Number.....	9	5	8	3	9	4	9	0	3	0	2	1	3	2	1	1	0	1	1	3	5

The median of these differences is 5.25 points and 11.5 is the upper quartile. Thus it seems that three-quarters of the differences are not significantly large, especially in view of the recent demonstration by Miss Cobb, that substantial discrepancies among Intelligence Quotients obtained on repeated examinations may be due to the nature of the Binet Scale itself.[2] There remain, however, about a quarter of the cases in which the difference is 10 points or over, and concerning these cases we wish to determine from the supplementary information available whether there is a reasonable basis for the change.

Number 3 when examined in 1918 was 5 years 9 months old and

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[1] This is not the first case study in this field. Special phases of the subject have been treated by several investigators. See especially Bronner, Augusta F.: Attitude as it Affects the Performance of Tests. *Psychological Review*, Vol. XXIII, July, 1916, pp. 300–301. The Diagnostic Fallibility of Intelligence Ratios. *Pedagogical Seminary*, December, 1918, pp. 369–392; and Jewett, Stephen P., and Blanchard, Phyllis: Influence of Affective Disturbances on Response to the Stanford-Binet Test. *Mental Hygiene*, Vol. VI, January, 1922, pp. 39–56.

[2] Cobb, Margaret V: One Element in the Probable Error of a Mental Age Measurement. *Journal of Educational Psychology*, Vol. XIII, No. 4, April, 1922.

tested 5-8, which gives a 99 IQ. It is interesting to note that he barely misses two tests, naming two coins instead of three, and saying he had 11 fingers instead of 10. On the short Doll Test his IQ was 110, and he did one form board at the 7-year level. The teachers reported him as shy and repressed, while the psychologist, after a comprehensive study, reported that he was a slow developing normal.

In 1919 he was 6 years 11 months at the time of the examination, and tested 7-0, with an IQ of 101. The interesting thing about this test is its wide scatter, as his basal year was 4, and he passed tests in year 10. In the 10th year he was given the Healy-Fernald form board as an alternate to the reading test, as he had not had instruction in reading, and he passed this test.

The following year, 1920, brought a queer slump in his record. He was then 7 years 9 months old but tested only 7-2, which caused his IQ to drop to 94. In this test he failed three tests which he had passed the previous year, and he was not given the chance to make points on the form board as previously. Had he passed these four his IQ would have been 101. This introduces a problem which is met over and over again in the consideration of these cases, and frequently some such performance will account almost entirely for a large IQ difference.

In 1921, when he tested 9-7, his age was 8 years 10 months and his IQ, 109. This year he passed again the tests which he got in 1919, but missed in 1920, and in the Ball and Field Test he jumped from a plan not worthy of credit in year VIII to one which was of superior value, and was credited in XII. This change alone gives him a 5-point gain in IQ, and possibly the rest of the gain came because he was tested on one of his best days under especially favorable conditions. It is possible that on the next test he may slump as he did in 1920. We may reasonably expect, however, that he has started on the development which was hinted at by his performance on the form boards and the Doll-Binet in 1918, and which the psychological examiner predicted would come. It should be noted that in the 4 years, in spite of the changes in IQ, there has been no change in his classification as normal according to the limits set by Terman.

Case No. 8 was 9 years 7 months old when first examined. As he was at the time 9 years 5 months old chronologically, his IQ was 98. A year later he tested only 9-3, and his IQ had dropped to 87, a loss of 11 points. An examination of the second record blanks shows that we have again to deal with the problem of the failure in previously

passed tests. He missed in 1921, three tests which he had passed the previous year, and this alone causes a drop of 7 points in his IQ. There are in this case, however, certain bits of evidence which lead us to believe that there may have been a real deterioration. The teachers report that he has very poor motor control, and that he finds it very hard to attend to what is going on in the classes. He has queer facial expressions which are almost grimaces at times, but which seem to mean nothing. He is continually in motion and some of his movements are very nearly contortions. These facts seem to indicate that there is some nervous defect aggravating this case, and that it would be quite the natural thing to find successive Intelligence Quotients varying considerably.

In case No. 15 we again find evidence of slight nervous disorder. This girl when first tested was 11 years 2 months old, and a mental age of 10-9 gave her an Intelligence Quotient of 95. A characteristic of her examination was the wide scatter of her successes. She missed one test in year IX, and two in X, but she went on to pass four in XII and two in XIV. The teacher in charge of physical training reports that she is "quite undeveloped physically for her age," and the psychologist mentions a psychopathic tendency. When the annual reports were sent out the parents of this girl were warned that she was in danger of a nervous breakdown.

Thirteen months later her record was as follows; MA, 12-3; CA, 12-2; IQ, 101. There was considerably less scatter in this test, but she missed four tests which she got the year before, two in XII, and two in XIV.

In 1920 she was 13-2 at the time of the examination, and tested 13-6. This gives her an IQ of 103. She missed two tests in XII, one which she got the previous year, and one which she got on her first test in 1918. The teachers report that she was very self conscious. Her work was very irregular; she was very poor in the gymnasium work, mediocre in Science and Music, and excelled in Literature.

On her last test, in 1921, she scored 15-1 and as her chronological age was 14-1 she obtained an Intelligence Quotient of 107. Again she missed two previously passed tests, in one of which she had obtained credit on *two* previous examinations.

It seems fair to conclude in this case that we are dealing with a somewhat unstable personality, and in such circumstances we could hardly expect the IQ to remain constant. The continual increase during the 4 years of the rate of mental growth may indicate that the

girl was given especial care and careful training after the initial warning to the parents.

There is another factor which introduces complications into this case. At the time of the first examination the girl was reported to be physically retarded. Comparisons of her height and weight with Baldwin's Standards show that in 1918 she was 0.593 AD below children of her age in height, and 1.31 AD under the average weight. In 1920 she was 0.032 AD *over* height, and only 0.468 AD under weight. A study of the ossification of her wrist bones and of her dentition at this later date indicated that she was at least normal, and possibly somewhat accelerated. All these facts indicate that there has been at some time during the 4 years a period of rapid physical growth, and so it is not surprising to find in the changes of the Intelligence Quotient some evidence of a rapid mental development as well.

A most interesting case is presented by No. 16, a girl who was 9 years 11 months when first tested. She secured a mental age of only a month less, which made her IQ 99. There was nothing out of the ordinary about her examination except that her reactions were reported very slow. The teachers reported that she was quiet, reserved, bashful, timid, repressed, and slow in motor reactions. At the end of the summer, however, all reports noted that she had improved to a marked degree. As one teacher put it, she was "slowly coming out of her shell."

The next year, when she was 10-11 she earned a mental age of 12-3, and her Intelligence Quotient rose to 112. The examiner reported as follows: "Her IQ may be higher. She has great trouble in expressing herself. Standards of her own answers are very high. Won't answer unless she is sure; refuses to guess." The teachers made the same kind of reports this year.

On the next examination, taken when she was exactly 12, her mental age was 14-2. This raised her Intelligence Quotient to 118. Once more the teachers reported her as slow, reticent, bashful, repressed, at the beginning of the summer, but noted later in the summer very marked changes. One report says: "Remarkable development during the last week."

In 1921, when she was 13, her mental age was 17-8. This makes her Intelligence Quotient 136, a gain of 37 points since the first examination. The teachers reported her as quiet and reserved, but not so much is made of this side of her nature as in the earlier years. The physical training instructor makes a very significant statement: "She has passed through a period of very rapid growth."

It is in this rapid growth that we may find the explanation of the rapid mental development. The contrast is well shown when her height and weight are compared with Baldwin's standards. Her

	1918	1921
Height.....	0.586 AD	1.40 AD
Weight.....	0.325 AD	0.511 AD

physical development was retarded at the time of the first examination and it is reasonable to infer that there was mental retardation as well. With the acceleration of the one came the acceleration of the other.

Number 22 was first examined when she was only 2 years 8 months old. Her performance was somewhat out of the ordinary, in that she was able to obtain credit for the description of pictures in year VII, in spite of the fact that she missed all the tests in year V and all but the alternate in year VI. As she had been given no opportunity to learn the names of coins she was given the time orientation test in VI and passed. With these credits her IQ is 138, without them it drops to 125.

She was not examined again until 2 years later, when she was 4 years 8 months old. This year she was not able to describe the pictures, though she had done it creditably 2 years before. No allowance was made for her lack of acquaintance with the coins, and her IQ on this basis was 125. Had she obtained credit for picture description and the time orientation in VI, the resulting IQ would have been 133.

On her last examination (1922) at the age of 5 years 9 months she made a mental age of 6 years 10 months, with an IQ of 119. She did not know the coins at this time, and credit for the time orientation was not given. With this credit the IQ would have been 122.

This case presents a very good illustration of a large difference in IQ resulting from what appears to be a chance success, for it seems that we must attribute to chance the successful description of pictures by a subject only slightly over 2½ years old. We also find a complication due to the use of an alternate test, and the question arises as to how far this is permissible. Undoubtedly it was justified in the first examination, but the case is not so clear when the subject is nearly 6 years old.

Case No. 23, a girl, was 9 years old when first examined, but tested only 7-8, which gave her an IQ of 85. She missed the coins in VI, could not draw a satisfactory diamond in VII, and failed on three tests in VIII; Ball and Field, counting backwards, and definitions.

In two subsequent years her Intelligence Quotients were 102 and 100. The explanation of this rise may be found in the fact that this girl was confined to her bed during the first 5 years of her life, and so did not have the range of experiences of the ordinary child. The first test came before she had been out in the world long enough to catch up in her development. Another factor has a slight influence in this case. In each of the later years there was one test on which she was given credit for rather doubtful responses. Giving her the benefit of the doubt raised the IQ's two or three points. Also, on the first examination there were two tests which she barely missed. Had she passed these her IQ would have been at least four points higher.

Case No. 24 is a boy who was 8 years 6 months old when the first examination was given. He tested 9-8, which made his IQ 114. The examiner reported that he was seemingly only partly interested in the work, and this seems to be borne out by the fact that he scattered widely, as the basal year was VII, and he passed tests in every year to XVI, inclusive. A little later he was examined on the Doll Short Test, and secured an IQ of 125. The teachers reported that he was prone to bluff, was self-centered and superficial.

A little over a year later he was 9 years 8 months old, and tested 10-10 with an IQ of 112. He failed many of the tests in which he had been successful the previous year, and but for this would have had a much higher IQ, as these misses total nearly a year. It is also noticeable that he barely misses several tests. For instance, he interpreted one picture, and gave partially interpretative responses for two others. Also, he missed the arithmetic problems in XIV because he gave the answer to the first as 50 days rather than 50 weeks. On the Yerkes Point Scale examination he secured a CIA of 124.

No examination was given to this subject in the following year, but in 1921, when he was 11 years 8 months old, he tested 14-6 with an IQ of 124. It is interesting to note, in view of the wide scatter on the first examination, that on the last the base was XIV, and only one other test was passed—Binet's Paper Cutting Test in XVIII.

It seems reasonable to suppose that the lower IQ's resulting from the first examinations were due to the failure of the subject to put forth his full effort during the testing. The fact that each year he did better on other examinations is evidence in support of this supposition. This case offers a very convincing argument for the scientific method of determining an IQ on the basis of a number of measurements.

Case No. 25 presents what is perhaps the hardest problem for

analysis in the whole group. At the time of the first examination he was 10 years 5 months old, and he tested 12 years 11 months with an IQ of 124. The next summer he was 11-7 when examined, and he tested 15-2 which gave an IQ of 131. The third examination found him 12 years 6 months old, and he earned a mental age of 17-0 by getting all the tests in XVI and two in XVIII. This gave him an IQ of 136, 12 points above that obtained on the first examination.

Unfortunately, we have not the data to check up this boy on the physical side, as his height and weight were not reported for the third year. It is possible that some explanation might be found in accelerated growth, but as he was well above the average in 1918 this does not seem likely. The writer is inclined to believe that here we have differences due to the chance success or failure in tests of the upper years where the credit for a single test is large. If he had passed one test from year XVI on his first examination his IQ would have been raised four points. On the other hand, if he had missed one of the year XVIII tests which he got on the last examination there would have been a drop of four points in the IQ.

Number 26 is the brother of 25. He was first examined when he was 6 years 1 month old and tested 8-11. This gave him an IQ of 147. He had been sickly since birth, and was reported as very unevenly developed. The teachers reported that the summer's work made a great improvement in every way.

On the second examination when he was 7-3, he tested 10-5, with an IQ of 144, and he got 7 points out of the 8 necessary for credit in the fable test of year XVI. Had he passed this test his IQ would have been 150.

On the third and fourth examinations he made IQ's of 166 and 167, a gain of about 20 points over the first two. It seems likely that the results of these later examinations show his correct mental status. At the time of the first and second examinations he had not been taught to read, and because of this he did not have the necessary background for answering correctly some of the more advanced tests. Also, his poor health had prevented the acquiring of much social experience, as he was not in school with other children. With his improving health and his entrance into school these deficiencies were made up, and he was able to reach his true level on the later examinations.

The cases to be considered in the second part of this study (See Table II) are school children examined by the staff and students in

training at the Psycho-Educational Clinic of the Harvard Graduate School of Education. For the most part these were children who were not getting along in their school work, and the examinations were made in the attempt to determine how the methods of their education could best be altered to suit their needs and abilities. The time between examinations ranged from less than a month to 15 months.

The distribution of the differences is as follows:

Points	0	1	2	3	4	5	6	7	8	13	19
Number	3	2	3	1	2	2	0	1	1	1	1

The median difference is 3.5, and only four cases show a difference of more than 5 points.

TABLE II.—INTELLIGENCE QUOTIENTS OF CLINIC CASES

Number	Date	First test		IQ	Date	Second test		IQ
		CA	MA			CA	MA	
5	May, 1920.....	12–8	10–4	81	Oct., 1920.....	13–2	11–5	89
38	Jan., 1920.....	8–0	7–4	92	May, 1921.....	9–4	7–11	85
44	Apr., 1920.....	12–8	9–9½	77	Oct., 1920.....	13–2	9–5	72
45	May, 1920.....	12–2	8–4	69	Oct., 1920.....	12–6	8–8	69
49	Jan., 1920.....	5–9	3–10	67	June, 1921.....	7–2	6–2	86
59	Jan., 1920.....	9–6	7–9	83	May, 1921.....	10–11	8–10	81
67	Apr., 1919.....	7–9	9–0	116	May, 1920.....	8–10	11–1	113
101	Nov., 1919.....	8–1	6–6	80	Dec., 1919.....	8–1	6–6	80
111	Oct., 1919.....	8–5	7–6	89	Feb., 1921.....	9–9	8–2	84
121	Apr., 1920.....	13–0	8–8	66	Oct., 1920.....	13–7	9–4	68
123	Jan., 1920.....	5–11	4–10	82	Nov., 1920.....	6–9	5–10	82
130	Jan., 1920.....	5–6	4–2	76	Nov., 1920.....	6–5	5–9	89
133	Nov., 1920.....	12–11	16–5	127	Jan., 1922.....	14–1	17–4	123
147	Apr., 1919.....	11–8	13–10	119	May, 1920.....	12–9	15–6	121
148	Jan., 1920.....	9–2	7–4	80	May, 1921.....	10–6	8–0	76
171	Dec., 1919.....	9–9	8–4	85	Nov., 1920.....	10–9	9–3	86

There are only two cases in this group which need discussion. Number 49 was first tested at the age of 5 years 9 months when he was in Grade I. He earned a mental age of only 3-10, which made his IQ 69. It was found upon inquiry from the school authorities that he had spent the whole previous year in the kindergarten without speaking once. In every other way he seemed normal. His parents were recently arrived immigrants. In the form board tests he did much

better than his mental age would seem to warrant, and diagnosis was deferred with the recommendation that he be retested later. On the reexamination, which was given 15 months later, he made an IQ of 86. It seems reasonable to suppose that the difficulties which he experienced on the first examination were largely linguistic. As he gained a greater command of English he was able to pass more of the tests, and so made a higher mental age. This supposition is borne out by the fact that most of his failures on the first examination are found to be in the linguistic tests.

Number 130 was first tested when he was 5 years 6 months old. His mental age on the examination was 4-2, giving him an IQ of 76. Nine months later he obtained an IQ of 89. Investigation showed that he had only been in school a few months at the time of the first examination, and that he had not been in the same school during that time. He did not even know his name when first tested. He came from a markedly inferior home, and it seems likely that the conditions of his environment were such that he did not have the opportunity to learn as the normal child of his age. In the school some of this deficiency was remedied, and thus the improvement on the second examination.

The causes of the Intelligence Quotient differences which have been pointed out in the previous case studies may be grouped under a few general heads. We find in the first place indications that some differences are due merely to fluctuations in ability, interest, attention, or whatever we may choose to call it. This is a very common phenomenon in all phases of endeavor, and it would be very remarkable if it did not appear in the results of mental examinations. It is probable that the differences which may be attributed to this cause are for the most part small, but at times the fluctuations may be large and the IQ differences great. These fluctuations are more significant than they otherwise might be on account of the large units in which the Binet Scales measure. It seems likely that many of these differences would disappear if we adopted the more scientific plan of taking several measurements instead of one.

In some cases the fluctuations are so great that they can not be said to indicate simply temporary variations in efficiency but rather an unstable or psychopathic personality. It seems that this conclusion must be reached when a subject fails in a considerable number of tests which he passed in previous years. This factor has been present in at least two of the cases presented in this study, as shown by the supplementary information obtained.

There are undoubtedly children who are temporarily retarded in their mental growth as they are retarded physically and physiologically. In these cases it is reasonable to expect a substantial increase in the Intelligence Quotient as the development proceeds.

Sometimes the differences may be due to some deficiency in the training or environment of the subject. If a child has not had the ordinary education and experience of the average child of his age he can not be expected to pass all the tests. Differences of this sort may be expected to appear when the subject has not become thoroughly familiar with English or when poor health has kept him from school or from the usual play activities in which he might be expected to take part. This factor is also of considerable influence in the case of a very superior young child, as he has not had the experience which would enable him to pass the more advanced tests.

The record which any individual makes on an intelligence examination is not due to his native capacity or natural endowments alone. It is influenced by his mental health, the stage of development of his innate ability, and the general environment, including formal and informal education, to which he has been subjected. Most children are mentally sound and sane, they develop at nearly the average rate, and they grow under the ordinary circumstances of environment. In such cases substantial constancy of Intelligence Quotients may reasonably be expected. This study seems to indicate pretty clearly that when large differences in Intelligence Quotients appear there may be found some reason for them. Thus the discrepancies do not lessen the value of the Intelligence Quotient but increase its usefulness, providing always that a scientific case study of the individual is made.

A REPORT ON THE CORRELATION OF PSYCHOLOGICAL TESTS WITH ACADEMIC AND MANUAL SUBJECTS[1]

IRENE GLENN

North Bennett Industrial School, Boston, Mass.

The work reported on in the following was undertaken on the hypothesis that individual differences in vocational fitness exist among children of the ages found in the grades preceding high school, and that they exist to such an extent that all children cannot efficiently be included in the same curriculum. We have sought to determine where some of these differences lie and by what tests they may best be indicated.

The subjects for this experiment were in the Grades VI, VII and VIII. It is in Grade VII in Somerville that manual training is introduced in the curriculum, Grade VI including only the simplest hand work and drawing. In general the children came from lower middle class homes and represented a variety of races.

The following tests were used:

General Intelligence

Binet-Simon (Terman Revision, Abbreviated Scale).
Pintner Non-language Mental Test.
Myers' Mental Measure.

Academic

Woody-McCall Mixed Fundamentals, Form II.
Trabue Language Scale C.
Thorndike Scale Alpha 2 (Parts 1 and 2) for Measuring the Understanding of Sentences.
Directions Test (hard).

Motor Tests

Healy Psychomotor (tapping) Test (used as a group test).
Star Test (individual).
Wells' Peg Test (individual).
Paper-folding Test (individual).
Lane Test (individual).

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[1] This article is a report on a part of the research which is being supported and conducted by the North Bennet Street Industrial School, Boston, Mass. The School is indebted to Mr. Charles S. Clark, Superintendent of Schools, Somerville, Mass., for his cooperation in opening his classes to the experimentation.

Except for the directions test, the academic tests are fairly analogous to the academic subjects in the curriculum. In choosing the motor tests, our main object (aside from simplicity and practicability) was that they should be as purely motor as possible. Puzzles or construction tests of a problem nature, though involving no language, have been avoided. The work was originally planned so that all classes were to receive all the tests, but the addition of further tests and the time required by others, operated to limit the number of classes to which certain tests could be given. All examinations for a given test came as near as possible in point of time. For each of the standard tests, the procedure and scoring used was that given by its author. The method of scoring for the Thorndike Alpha 2 was that adapted to individual testing by T. L. Kelley.

Detailed instructions for ranking pupils on class work were given to each teacher, the method being that of selecting the best, the poorest, and an average child, then selecting the children whose ability was between the extremes and the average, and finally filling in all others in relation to these five. The coefficients were calculated for each class separately. The footrule formula was used, R being transmuted into r.

On the whole the correlations are low but this is to be expected since the groups are small and fairly homogeneous. Academic subjects show a marked tendency toward a negative relation with motor

TABLE I.—SHOWING NUMBER OF MEASURES USED IN CALCULATION OF COEFFICIENTS

Grade	Class	Total number of children (*i.e.*, number taking academic subjects)	Number of boys taking manual training	Number of girls taking manual training
VI	VI3	22		
	VI1	45		
	VI2	37		
VII	II	42	25	17
	I2	46	28	18
	I*F*	34	22	12
VIII	II2	40	29	11
	II3	31	..	19
	II*F*	35	14	

TABLE II.—AVERAGES OF COEFFICIENTS OF CORRELATION FOR GENERAL INTELLIGENCE AND ACADEMIC TESTS WITH SCHOOL SUBJECTS[1]

	Pintner	Myers	Binet	Woody	Trabue	Thorndike	Directions
English	.20(8)	.27(5)	.28(5)	.41(8)	.34(8)	.59(3)	.69
	.04–	−.11–	−.11–	.24–	−.06–	.55–	
	.46	.35	.46	.67	.62	.65	
History	.32(6)	.38(4)	.56(4)	.29(6)	.32(6)	.41(2)	
	.11–	.28–	.47–	.04–	.19–	.41 &	.43
	.55	.54	.61	.57	.59	.41	
Geography	.17(2)	.16(2)	.40(2)	.60	.37	.52	.71
	.04 &	.09 &	.32 &				
	.30	.22	.49				
Arithmetic	.27(9)	.26(6)	.28(6)	.67(8)	.23(8)	.48(4)	.38(2)
	.01–	.11–	−.11–	.47–	.04–	.28–	.29 &
	.50	.34	.55	.86	.47	.80	.47
Woodworking	.35(5)	.19(3)	.14(3)	.11(5)	−.03(5)	.06(2)	.42
	.12–	−.23–	.00–	.04–	−.42–	−.08 &	
	.88	.46	.31	.26	.33	.19	
Woodworking	.55(3)	.14(2)	.30(2)	.38(3)	.12(3)	.23(2)	−.11
	.37–	.08 &	.23 &	.34–	−.12–	.01 &	
	.90	.21	.37	.46	.50	.45	
Sewing	.14(5)	.04(4)	.24(4)	.28(5)	.08(5)	.18(2)	−.14
	−.09–	−.14–	−.18–	.13–	−.13–	.00 &	
	.39	.38	.73	.43	.26	.37	
Cooking	.26(4)	.32(3)	.31(3)	.07(4)	.12(4)	.30(2)	.00
	.12–	−.02–	.01–	−.34–	−.26–	.08 &	
	.52	.50	.55	.34	.82	.52	
Bookbinding	.25	.31	.02	−.21	.09		

tests. On the other hand their correlations with the academic tests are on the whole higher even than those with general intelligence. That is, of course to be expected. The relation of the manual subjects to the tests is irregular, but there are very definite tendencies toward the relation being positive in the case of the manual tests and negative or very low in the case of the academic tests. The greater variability evident here, may be due, in part, to other causes than factors inherent in the tests themselves. The criteria whereby a teacher may rank pupils in manual work are not so exact as those for academic work. Character traits of confidence and obedience, habits of industry and neatness, are all more evident in classes of manual training where groups are smaller and freedom greater. In consequence, we can not expect that the estimates given by the teachers for these subjects shall represent only the manual skill of the pupils. The tests, on the other hand, exclude to a great extent everything except manual skill.

[1] The figure in parenthesis indicates the number of coefficients represented in the average and beneath is given the range of the distribution of the coefficients.

TABLE III.—AVERAGES OF COEFFICIENTS OF CORRELATION FOR MOTOR TESTS WITH SCHOOL SUBJECTS

	Psychomotor	Wells	Star	Folding	Lane
English.....	.01(8) −.18−.18	−.13(5) −.41−.17	−.05(3) −.34−.17	−.02(3) −.10−.03	.03(3) −.05−.11
History.....	−.10(6) −.28−.18	−.09(4) −.32−.11	−.04(4) −.21 & .14	−.03(2) −.13 & .19	−.06(2) −.18 & .06
Geography.....	−.14(2) −.26 & −.02	.24(2) .12 & .37	.05(2) −.02 & .12		
Arithmetic.....	.00(9) −.20−.26	.04(6) −.32−.34	−.10(4) −.43−.15	.11(3) −.10−.40	−.05(3) −.13−.00
Woodworking.....	.22(5) −.12−.43	.13(3) −.05−.22	.22(2) .21 & .22	.50	.21(2) .21 & .21
Woodworking.....	.29(4) .09−.50	.14	.....	.49	.34(2) .30 & .38
Sewing.....	.30(5) .08−.58	.28(3) −.18−.68	.11	.67	−.03(2) −.05 & −.01
Cooking.....	.04(4) −.18−.40	.08(2) −.26 & .41	.11	.08	−.24(2) −.37 & −.12
Bookbinding.....	.43	.24	.41		

We find, then, that our hypothesis regarding the differentiation of abilities at the ages represented by our subjects has a basis in test results as well as in the experience of educators. Speaking very generally these abilities may be grouped as relating to language or to motor facility, and this broad differentiation is substantiated by comparisons of the ranks of the children in the various class subjects. The average correlations between the different academic subjects are from 0.60 to 0.80, whereas a comparison of academic subjects with hand work gives average coefficients varying from 0.12 to 0.42. However, we can not compare, for instance, the correlation between the Psychomotor Test and woodwork, with the correlation between academic subjects and woodwork and thereby say that success in English is the better indication of the child's future success at hand work than the Psychomotor Test. For there is a high probability of the same influencing factors being present in both the ratings of the academic teacher and those of the woodworking teacher, which cause them to be similar and thus raise the coefficient above that obtained by comparing a test with either set of ratings.

With so little correspondence between proficiency in the academic subjects and proficiency in motor tests or motor work, the academic record alone would be an entirely inadequate basis for guidance to such courses of training. Considering the tests as a basis, we find that it will be necessary to work out combinations of tests diagnostic of capability in each subject. For, especially in the manual training group, the several subjects can hardly be designated as representing exclusively one type of aptitude or the other, nor can one group of tests be applied as indicative of possible success in all lines of manual work. Certain subjects constituting a manual training course demand abilities quite the reverse of each other. The tests correlating with marks in cooking are of general intelligence and language comprehension, while those correlating with sewing are tests of speed and precision of finger movement. Yet at present, a girl choosing the manual training course, automatically takes both of these subjects. A combination of Pintner's Non-language Test and the Psychomotor would form part of a group for prognosing success at woodworking. Bookbinding might require a group of tests similar to those for sewing. The Thorndike test exceeds all others, even those of general intelligence, for the prognosis of general academic success. English is especially related to this test. History, it will be noted, shows excellent correspondence with general intelligence—being particularly high even with the non-language tests.

The above correlations on academic subjects augment similar correlations already made by other investigators. Those on the manual work, I believe, constitute the first group contributing to the solution of the problems of the selection of children for manual training courses. They are offered as a basis for further study. Analysis by means of correlations of the abilities demanded by school subjects will in all probability aid in the better formation of courses of study and in the solution of problems of individual adjustment.

THE EFFECT OF THE STUDY OF LATIN ON ABILITY TO DEFINE WORDS

A. R. GILLILAND

Lafayette College

The value of the study of latin—granting that such value exists—should be as amenable to measurement as are other educational products. More or less successful attempts at such measurements have been reported by Swift, Starch, Partridge, Harris and Foster.[1] The surprising generalization that can be made from these studies is the small amount of increased ability that is to be found in students with Latin training either to get on in other languages or to define words. After necessary deduction has been made for the fact that the organization of our school systems and the prejudice of educated parents have tended to influence the better students to elect Latin, little real difference seems to remain between the Latin and non-Latin groups.

The present study is similar to some of those already referred to with the exception that two attendant factors have been measured where formerly none or, at most, only one has been controlled or measured. The measurement of ability to define words with groups of students that have not studied Latin, and groups that have studied the language for 2, 3, 4, or 5 years was obtained as well as the intelligence scores for these same groups. Also, the general standing in college for the first semester of the freshman year was secured.

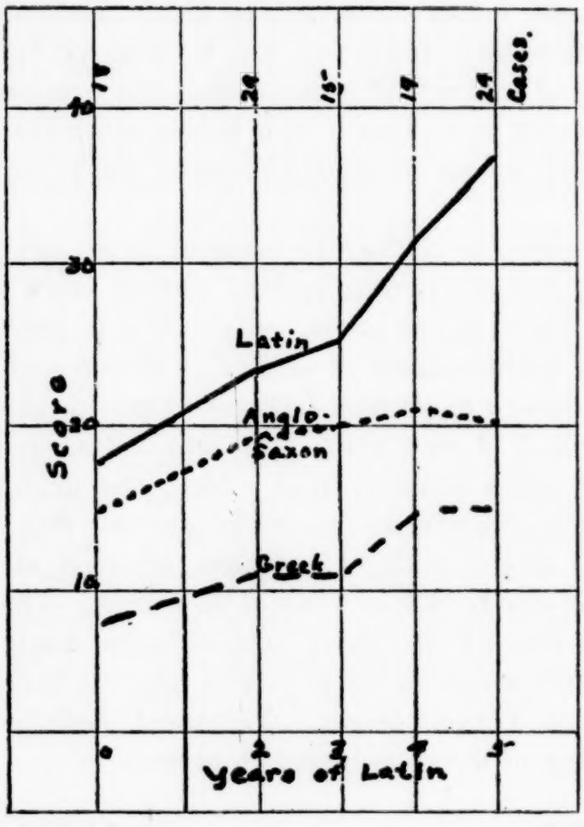
One hundred fifteen college freshmen, selected at random, were tested on their ability to define a list of 40 words. The first 10 words of the list were English words of Anglo-Saxon origin; the next 20 words were English words of Latin origin, and the last 10 words were English words of Greek origin. Technical definitions were not required. The list of words is herewith given.

Anglo-Saxon Origin		Greek Origin	
tithe	bier	synchronize	anthrópomorphous
midwife	dowery	phenomenon	bibliophile
cog	budget	lithograph	polychrome
broach	bolster	photometer	genesis
cooper	squib	heterodox	pantheism

[1] See brief review of these reports by Daniel Starch in Educational Psychology; 1920, pp. 230–236.

	Latin Origin	
ossify	impeccable	congenital
omnscience	translucent	sanguinary
hibernate	litigation	extirpate
predatory	moratorium	mendacity
impecunious	quadruped	parricide
adhesion	supernatant	irrefragable
malleable	longevity	

The words were given orally and in order by one or the other of two experimenters. In grading, each correct definition was given three points credit. When the general idea of the word was given but lacking in some more or less essential detail, a credit of two points



Graph I.—Showing the scores on the test in defining words of Anglo-Saxon, Latin, and Greek origin.

was given. Where there was a very hazy idea or mere ability to use a word in a sentence, without a clear notion of its meaning, one point credit was given. On this basis the Angle-Saxon group of words could give a maximum credit of 30 points, the Latin words 60 points, and

the Greek words 30 points, or 120 points credit for correct definitions of the whole list of 40 words. To insure uniformity in grading, one experimenter graded all the papers and the other experimenter made a re-checking to prevent errors or unfair grading.

The accompanying table gives the scores for each subject grouped on the basis of the years the subject had studied Latin. High school and college Latin were combined and since the experiment was conducted in the spring, college Latin was counted as a full year. The scores for each of the three groups of words have been kept separate in the table.

Graph I shows the increase in ability to define English words of Anglo-Saxon, Latin and Greek origin dependent upon the number of years spent in the study of Latin. Not only were those who had studied more Latin able to define more words of Latin origin but they were also able to define more words of Anglo-Saxon and Greek origin appreciably better. One or the other or probably both of two factors account for this. Either the men who had studied Latin for a longer time had a greater native capacity for language, or at least for Latin, or the study of Latin developed a method of attack which helped in defining any type of word. Probably those who studied Latin for several years *did* have more ability for Latin or a greater interest in the subject that the rest, otherwise it would have been dropped. In a large number of cases the study of Latin seemed to have developed a method of attacking new words, illustrated by numerous attempts to break these words up into their component parts. Admittedly the possible greater native ability for Latin in the groups with more years spent on Latin is a complicating factor which can not be isolated nor accurately measured in the present study.

TABLE 1

Anglo-Saxon	Latin	Greek
No Latin		
22	20	13
13	23	7
12	26	8
10	20	10
11	17	5
12	17	9
15	29	17
17	14	3
15	20	1
13	9	2
16	16	1
12	13	0
9	8	3
17	14	5
12	20	5
9	12	5
12	14	7
9	4	5
15	13	9
12	19	16
20	11	10
26	35	13
27	24	15
Average		
14.6	17.3	7.3
Average Deviation		
3.9	5.4	4.0
2 Years Latin		
24	22	16
16	27	12
18	25	7
20	45	20
14	10	6
18	24	9
15	22	8
16	24	7
17	24	12
24	22	10
16	28	15
21	22	12
21	14	5
17	22	9
14	24	8
20	41	11
20	29	12
21	6	7
18	18	14
29	25	17
25	25	10
20	22	8
27	26	8
20	24	13
5	17	6
21	38	14
17	12	3
11	13	6
16	42	18
23	16	9
13	17	5
27	34	29

Anglo-Saxon	Latin	Greek
Average		
18.9	23.1	10.3
Average Deviation		
3.8	6.4	4.0
3 Years Latin		
17	19	5
17	23	8
18	31	7
13	21	12
20	27	8
20	25	5
22	24	9
21	19	7
16	30	16
20	24	12
21	26	14
28	34	17
22	16	11
19	26	11
Average		
19.6	24.6	10.2
Average Deviation		
2.4	3.8	3.2
4 Years Latin		
26	31	13
21	37	22
21	40	12
20	36	10
21	40	13
16	44	17
18	36	12
20	44	23
21	43	18
18	42	15
21	36	25
27	28	9
25	20	12
22	21	9
28	44	12
22	26	12
26	34	20
23	35	14
Average		
20.6	31.5	14.2
Average Deviation		
2.5	8.2	3.8

TABLE 1.—*Continued*

Anglo-Saxon	Latin	Greek
5 Years Latin		
26	47	18
24	52	18
24	49	22
14	19	5
25	46	22
16	42	20
20	36	15
25	44	20
22	44	18
26	42	18
8	20	3
16	30	4
22	40	19
23	38	10
24	47	17
25	33	10
24	51	19
19	34	15
21	31	14
22	32	14
12	29	20
19	26	12
18	25	7
24	42	16
16	18	6
Average		
20.0	36.7	14.6
Average Deviation		
4.0	8.0	4.7
6 Years Latin		
22	51	18
20	39	7
Average		
21.0	45.0	12.5
Average Deviation		
1.0	6.0	5.5

NOTES ON ARTICLES IN EDUCATIONAL PSYCHOLOGY IN CURRENT ISSUES OF OTHER MAGAZINES

REPORTED BY CECILE COLLOTON

Department of Educational Psychology, The Lincoln School of Teachers College

Intelligence Tests

The Present Status of Mental Testing. Stephen S. Colvin. Educational Review, 1922, October, 196–206. A summary of the development of intelligence tests and a discussion of the general principles underlying their use.

The Attainment of Pupils on Certain Group Intelligence Tests. Dora Keen Mohlman. School and Society, 1922, Sept. 25, 359–363. Six tables report median scores, Grades VII–XII, for the following group tests; National, Otis, Terman, Indiana, Haggerty and Army Alpha. Three tables report median scores, Grades I–VI, for the Holley Picture Completion, Haggerty Delta 1, and the Illinois Examination. Data are taken from 22 investigations.

Undeveloped Resources: Some Studies in Group Intelligence in Sioux City High School. Robin Lynn Hamilton. School and Society, 1922, Oct. 7, 416–420. Eleven studies of the mentality of high school students as shown by the Army Alpha test and its relation to achievement, failure, elimination, etc.

Attempts at Test Validation. Raymond Franzen. Journal of Educational Research, 1922, September, 145–158. An investigation of 14 intelligence tests with reference to their correlation with certain defined criteria. Pleads for fewer tests and better construction.

Can Teachers Select Bright and Dull Pupils? G. F. Verner. Journal of Educational Research, 1922, September, 126–132. A comparison of the upper and lower per cent of 286 children in the schools of St. Paul, Minnesota as selected by the teachers with the intelligence quotients as determined by group intelligence tests. Teachers estimates unreliable.

The Mental Age of Adults. Edward A. Lincoln. Journal of Educational Research, 1922, September, 133–144. Is the mental age of adults 16 years as assumed by Terman, or 13½ as shown by the army results? Discusses Terman's objections to the inferences from the army testing.

Some Reactions to Standardized Tests. Emilie V. Jacobs. The Journal of Educational Method, 1922, September, 33–36. A grouping of VII*B* and VIII*A* pupil on the basis of Haggerty Intelligence Test IQ's. Opinions of eight teachers on the value of such a classification.

A Mass Mental Test for Use With Kindergarten and First Grade Children. Clara H. Town. Journal of Applied Psychology, 1922, June, 89–112. Description of a non-verbal test for use with young children. The "Picture Game" is reproduced in full and complete directions for its use are given as well as experimental results.

The Selection of a Successful Secretary. A. T. Poffenberger. Journal of Applied Psychology, 1922, June, 156–160. Results of the trail of the Army Alpha intelligence test in a secretarial school.

A Glimpse of High School Courses as Measured by the Otis Test. Ruth S. Clark. Journal of Applied Psychology, 1922, June, 185–191. A study of the Academic, the Commercial, the Technical, the Industrial Arts, and the Dressmaking Courses in High School shows various levels of intelligence within the groups.

Occupational-intelligence Standards. Douglas Fryer. School and Society, 1922, Sept 2, 273–277. A classification of 96 occupational designations on the basis of the average intelligence score as determined by Army Alpha and "Business Alpha." Of value for vocational guidance.

Educational Tests

Scores Made by Seniors on the Hotz Algebra Scales Compared with Scores Made by High School Students Taking Algebra. Clifford Woody. School and Society, 1922, Sept. 9, 303–306. Seniors retain a relatively large amount of knowledge of the formal aspect of algebra but fall very low in the ability to solve written problems.

Recent Developments in Silent Reading Tests. C. R. Stone. Journal of Educational Research, 1922, September, 102–115. Part I—a discussion of three types of silent-reading tests with illustrations. Part II—a detailed account of the construction and use of the Stone Series of Narrative Reading Tests.

Miscellaneous

Subsequent History of E—; Five Years After the Initial Report. L. S. Hollingworth, C. G. Garrison and Agnes Burke. Journal of Applied Psychology, 1922, June, 205–210. Mental and physical measurements and scholastic achievements of a child with an IQ of 187.

Repetition versus Other Factors in Learning. J. W. Barton. The Pedagogical Seminary, 1922, September, 283–287. Urges more attention to (1) readiness (native and acquired nature), (2) stimulation in keeping with this nature, and (3) knowledge of results through objective checks.

The Social Purpose of the Education of the Gifted Child. George S. Counts. Educational Review, 1922, October, 233–244. Importance of the development of a strong sense of social obligation in the gifted child. General discussion of the present day trend in the education of children of talent.

Teachers vs. Mental Tests as Prophets of School Progress. Garry C. Myers. School and Society, 1922, Sept. 9, 300–303. Argues that correlation with school progress is not a true measure of the validity of an intelligence test. The average teacher prophesies future progress of pupils better than intelligence tests.

Improving the Reading Ability of College Students. Cliff W. Stone. The Journal of Educational Method, 1922, September, 8–23. An investigation of the reading ability of fifteen college classes. Methods of improvement used are described and results discussed.

NEW PUBLICATIONS IN EDUCATIONAL PSYCHOLOGY AND RELATED FIELDS OF EDUCATION

1. *Physical Training Psychologized.*—Two volumes[1] covering two distinctly separate aspects of physical training are included under this head. The first is concerned with formal exercise and corrective gymnastics. The author sets forth in forceful terms the psychological premises underlying physical training. He says, "In the past physical training has been largely esoteric. Its meaning, except in a most general sense, was hidden as if it were beyond the comprehension of the ordinary mind." He has endeavored to give physical training teachers suggestions which are exceedingly simple, manifestly productive of result and honestly, completely and powerfully true. He conceives the purpose of physical training to be the maintenance of good health, increased vigor, mental and physical efficiency and the promotion of neuro-muscular and psycho-motor education. In a historical statement he relates how dissatisfaction with prevailing practice led him in 1902 to determine: First, the definite results or objectives of physical training, to classify these and determine their relative worth; next to ascertain by what exercises and methods of instruction these ends could best be met; then to devise a comprehensive plan and test it by practice under varied conditions. During 20 years the suggestions have been put into practice by an ever widening circle of instructors. After reading this book, physical training teachers should have a keener realization of the principle underlying the success of their instructional activities and a sound technique for securing the desired pupil reactions. Those who are more specifically concerned with young children are referred to the other book, a volume contributed by an experienced playground worker. Observations and interpretations of the spontaneous and supervised play of children are assembled in an attempt to clarify the underlying philosophy and the psychological implications.

[1] Ward, Crampton C., M. D.: "The Pedagogy of Physical Training." The Macmillan Co., New York, 1922, pp. XV + 257 and Sies, Alice Corbin: Spontaneous and Supervised Play in Children. The Macmillan Co., New York, 1922, pp. XII + 442.

This book is admirably suited for use in connection with courses for prospective teachers and playground leaders, because of the abundance of illustrative material, the selected list of collateral readings, with topical references, textbook assignments, questions, and exercises included in the appendix. L. Z.

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2. *An Experimental Study of the Reading of Numerals.*[1]—To the already impressive list of reading monographs from the University of Chicago laboratories must be added Terry's study of the eye movements involved in reading isolated numerals and numerals incorporated in sentences or problems.

Part I reports four preliminary studies by introspective methods. A number of graduate students acted as subjects. For Part II photographic apparatus was used to record the eye movements of six adult subjects, three of whom had participated in the preliminary studies. Each subject read simple arithmetical problems, isolated numerals of various lengths and ordinary prose. The educational implications of the data are such that the present study is to be considered as introductory to more elaborate detailed inquiry into the development of the specific eye habits involved.

Of the conclusions drawn the following are particularly significant: Ordinary prose is read much faster than either the problem material or isolated numerals. Problems are invariably re-read in whole or in part before computation ensues. In the first reading only short, common or round numbers are read. The first reading is usually for the purpose of ascertaining the conditions of the problem. Partial first reading of the numerals is conducive to a quicker grasp of the meaning and conditions of the problem. The final chapter is a valuable discussion of the numerous practical applications of the conclusions to classroom teaching and contains definite recommendations which should find their way into practice. L. Z.

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3. *A Significant Contribution to the Psychology of Reading and Spelling.*[2]—This volume reports an exceedingly intensive diagnostic

[1] Terry, Paul Washington: How Numerals are Read. *Supplementary Educational Monograph*, No. 18. Department of Education of the University of Chicago, 1922, pp. XIII + 109.

[2] Gates, Arthur I.: The Psychology of Reading and Spelling with Special Reference to Disability. *Contributions to Education*, No. 129, Teachers College, Columbia University, 1922, pp. VII + 108.

investigation with far-reaching implications set forth in an unusually thoroughgoing interpretation of results. Over a hundred children in the classes of a single school were put through an inclusive battery of group tests and individual examinations covering mental ability, achievement in school subjects, reaction to visual stimuli and spoken words, and sensory and motor reactions. The results were subjected to the most careful statistical analysis. The technique used to discover causes of inability furnishes an approach to some of the vital problems which must be solved before we dare hope for scientifically determined remedial work. The serious reader cannot fail to be convinced of the urgency of a psychological analysis of school functions, and gets a new vision of the nature and scope of diagnostic research.

The critical discussion of the mooted subject of phonics is constructive, and certainly throws new light on the subject. Disagreement with the conclusions of other workers concerning the significance of eye movement habits calls for the reconsideration of the evidence and more careful discrimination between causes and effects.

Distinct relationships between perceptual phases of reading and spelling are shown, and numerous other factors contributing to spelling disability are discussed. In this connection the study shows that, in the nature of the case, the numerical statement of correlation may conceal rather than reveal important facts, because the causal relations may be different in the extremes of the distribution, while the correlational methods assume rectilinear regression.

The relative infrequency of actual cases of serious disability due to defects of the central nervous system is noted, and other causal factors are discussed under the following headings: (*A*) Unfavorable training and environmental influences, (*B*) Unfavorable behavior of a general character, (*C*) Defects of the sensory mechanisms, (*D*) Defects of motor mechanisms, (*E*) Defects of connecting mechanisms.

In conclusion Doctor Gates says:

> A case of inability to read affords frequently a tangle of difficulties that experts from several professional fields working together may be unable to disentangle. Such a situation portrays clearly the need of a new group of specialists who will make the solution of such problems their main work. It will demand a mastery of the knowledge and technique of several sciences. Such research is essential, not only because it is plainly desirable to diagnose and remedy the conditions underlying disability, but because the development of general methods of instruction depends upon such knowledge as these achievements will provide.

There are those who expect the average child to blossom into reading. The final sentence in this significant study applies here—

> It is folly to expect children to learn functions as complex as reading and spelling economically and effectively without instruction, and is equally futile to attempt to devise adequate methods of instruction without intimate knowledge of the constituents of these functions and the influence of a variety of factors upon them.

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4. *A Critical Study of Certain Silent Reading Tests.*[1]—This bulletin has to do with the determination of the comparative validity and reliability of some of the standardized silent reading tests which purport to measure rate and comprehension. One cannot help but wonder why in 1922 the Ayres-Burgess, and the Haggerty tests were not included and why certain other tests were included. These vagaries of selection make the conclusions inconclusive, regardless of the adequacy of investigational technique. The author in his preface suggests that the monograph may be of interest to students in the field of educational measurement. In this connection the bulletin may possibly be of help to instructors who are looking for type-studies to illustrate such problems as pertain to reliability, validity, constant and variable errors, and the correction of errors due to sampling. L. Z.

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5. *"After Tests, What Next?"* This is the question which the schoolman in 1922 is asking. He has now passed by the milestones of "What are intelligence tests?" and "Do the tests really measure intelligence?" It is with hope of suggesting to the educator what to do after he has given intelligence tests, that this book[2] has been published. It is a composite by many authors, showing different kinds of school reorganization prompted by the results of intelligence testing. So far most of these suggestions have been scattered here and there in various journals, and it is, therefore, useful to have the results of some definite "next steps after testing" bound together in one volume.

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[1] Monroe, Walter S.: A Critical Study of Certain Silent Reading Tests. *Bull.* 8, Vol. XIX, No. 22, Bureau of Educational Research, College of University of Illinois, Urbana, Ill., pp. 52.

[2] Terman, L. M.; Dickson, V. E.; Sutherland, A. H.; Franzen, R. H. and Fernald, G.: Intelligence Tests and School Reorganization. *Subcommittee Report, N. E. A.* World Book Co., 1922, pp. VIII + 111.

In no sense, however, does the present volume attempt to cover or, indeed, indicate all the possibilities which a testing program may open up. Neither is it a compendium of all the experimental work done up to the present time. Nevertheless, it is very suggestive and helpful.

In a capital introductory chapter Terman, as editor, sets forth some of the results of the testing movement up to the present time. He reminds us of the recency of the intelligence test. He indicates its rapid growth, giving an estimate of over two million children tested in 1920–21. He shows briefly the heterogeneity of mental ability of pupils in the same grade at the present time and argues for a policy of homogeneity of intelligence in grades by means of a multiple track system wherever possible.

The other contributions deal with specific work in various parts of the country. The several types of classes developed at Oakland are described by Dickson. He shows what is being done for the bright and for the dull child. With reference to the latter group he indicates how they are being moved on into the junior and senior high school by means of a reorganized curriculum to suit their special needs. To make the mentally slow child repeat again and again the work of a given grade is certainly not a solution of his difficulty. The brighter children are being handled so far as possible in special classes, and both plans of enriching the curriculum and increasing the speed are being tried.

Sutherland describes the Adjustment Rooms of Los Angeles and emphasizes the necessity of adjusting the curriculum to the mental level of the child. Franzen describes briefly the Accomplishment Quotient and gives some data from his Garden City experiment. He rightly emphasizes the need for making a better use of the intelligence of the brighter children in our schools. Tupper gives an account of the use of intelligence and educational tests in a small city school system, while Fernald gives a very brief account of her interesting work with children who have difficulty in spelling and reading. All the six chapters of the book are valuable and stimulating. There is, however, no logical connection between the various chapters. The book is merely a collection of articles by different writers. Nevertheless, the topics are timely and are well worth the attention of all teachers and educators.

R. P.